

## SECTION 03900

### REPAIR OF STRUCTURAL CONCRETE RESTORATION AND CLEANING

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED:

This section includes furnishing all materials, tools and labor to repair structural concrete as specified herein and shown on the drawings and shall include watertightness testing of repaired concrete structures.

##### 1.02 RELATED WORK

- A. 02300 – EARTHWORK

##### 1.03 SUBMITTALS

- A. Submit manufacturer's technical literature on all product brands proposed for use by the Contractor, to the Engineer for review. The submittal shall include the manufacturer's installation and/or applications instructions.
- B. When the Contractor proposes substitutions for acceptable brands of materials specified herein are proposed by the Contractor, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the Project.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Epoxy resin/Portland cement products shall be delivered in original factory packaging bearing identification of product, manufacturer, as well as batch number, and expiration date as applicable. Material safety data sheet for each product shall accompany all shipments.
- B. Store products in a location protected from damage, construction activity, precipitation and direct sunlight in strict accordance with the manufacturer's recommendations.
- C. Prior to use, condition products to appropriate temperature for use in accordance with the manufacturer's recommendations.
- D. Handle all products with appropriate precautions and care as stated on the material safety data sheet.

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E. Protect all products from freezing.

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1.05 PROJECT/SITE CONDITIONS FOR USE OF EPOXY RESIN/PORTLAND CEMENT MATERIALS:

- A. Project site conditions for use of epoxy resin/Portland cement materials shall be as follows:
1. Do not apply products on surfaces with an ambient temperature below 40F, nor above 85F.
  2. Do not use products under conditions of precipitation.
  3. Do not use products below and ambient air temperature of 40 degrees F during application and for a period of 24 hours thereafter.
  4. Protect all adjacent work when mixing and handling epoxy resin/Portland cement materials.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Sika Corporation, Procrete Industries (ProChem Technology, Inc.), Thoro Systems Products (ICI Specialty Chemicals), or approved equal.

2.02 MATERIALS:

A. Bonding Compound:

1. Epoxy bonding agent shall conform to ASTM C881 Type II.

A.

B. Water

1. Water for cleaning, mixing, and curing shall be potable water.

C. Polymer-Modified Mortar

1. Polymer-modified mortar shall consist of portland cement, fine aggregate, water, and polymer. Proportion mortar in accordance with manufacturer's recommendations.
2. Polymer modifier shall conform to ASTM C1438, Type II.
3. Physical Properties:
  - a. Compressive Strength: ASTM C109; minimum 5,000 psi @ 28 days.
  - b. Flexural Strength: ASTM C78; minimum 700 psi @ 28 days.
  - c. Splitting Tensile Strength: ASTM C496; minimum 450 psi @ 28 days.
  - d. Bond Strength: ASTM C882 modified; minimum 2,000 psi @ 28 days.
  - e. The polymer-modified mortar shall not produce a vapor barrier.

D. Polymer-Modified Concrete

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1. Polymer-modified concrete shall consist of portland cement, fine and coarse aggregate, water, and polymer. Proportion concrete in accordance with manufacturer's recommendations.
2. Polymer modifier shall conform to ASTM C1438, Type II.
3. For repairs greater than 1-inch in depth extend factory-packaged repair mortar with aggregate in accordance with manufacturers recommendations. Aggregate shall conform to ASTM C33 and shall be clean, well-graded, saturated surface dry aggregate, having low absorption and high density.
4. Physical Properties:
  - a. Compressive Strength: ASTM C109; minimum 5,000 psi @ 28 days.
  - b. Flexural Strength: ASTM C78; minimum 700 psi @ 28 days.
  - c. Splitting Tensile Strength: ASTM C496; minimum 450 psi @ 28 days.
  - d. Bond Strength: ASTM C882 modified; minimum 2,000 psi @ 28 days.
  - e. The polymer-modified concrete shall not produce a vapor barrier.

E. Polyurethane Injection Adhesive

1. Polyurethane injection adhesive shall be a two part system composed of polyurethane and water. Polyurethane resin shall be 100 percent hydrophilic resin, capable of forming either a flexible closed-cell foam or cured gel when mixed with water. When mixed with water the resin shall meet the following requirements:
  - a. Tensile Strength: ASTM D 1623, 20 psi minimum.
  - b. Elongation: ASTM D1623, 400% minimum.
  - c. Bond to Concrete (wet): ASTM C273, 20 psi minimum

F. Crack Surface Sealer for Injection Grouting

1. Crack surface sealer for injection grouting shall conform to ASTM C881, Type IV, Grade 3, Class B with mineral filler.

G. High Molecular Weight Methacrylate (HMWM) Sealer

1. High molecular weight methacrylate shall be a two-component, rapid curing, solvent free, penetrating sealer with components meeting the following requirements:
2. Sand for covering the HMWM shall meet the quality and grading requirements of aggregate for masonry mortar in accordance with ASTM C144.
3. HMWM Monomer: The monomer shall be a high molecular weight or substituted methacrylate that conforms to the following properties:
  - a. Vapor Pressure: ASTM D323, less than 0.02 psi at 77 degrees F
  - b. Flash point: Pensky-Martens CC, greater than 200 degrees F
  - c. Density: greater than 8.4 lb. Per gal. At 77 degrees F
  - d. Viscosity: ASTM D4016, 12 +/- 4 cps at 73 degrees F

- e. Index of Refraction: 1.470 +/- 0.002
  - f. Boiling Point @ 0.02 psi: 158 degrees F
  - g. Shrinkage on Cure: less than 11%
  - h. Glass Transition Temperature: ASTM D3418, 158 degrees F
  - i. Curing Time: greater than 40 minutes at 73 degrees F, with 4% cuemene hydroperoxide
  - j. Bond Strength: ASTM C882, greater than 1,500 psi.
4. Initiator/Promoter System
- a. Initiator Cuemene Hydroperoxide; 78 percent
  - b. Promoter Cobalt Napthenate; 6 percent
  - c. The initiator/promoter system shall be capable of providing a surface cure time of not less than 40 minutes nor more than 3 hours at the surface temperature of the concrete during application. The initiator/promoter system shall be such that the gel time may be adjusted to compensate for changes in temperature that may occur throughout the treatment application.
- H. Joint Sealant
- 1. Horizontal Joint Sealant: Pourable, two-component, cold-applied, self-leveling polysulfide or polyurethane based joint sealant.
  - 2. Horizontal joint sealant shall have the following characteristics:
    - a. Consistency: Liquid, Self-Leveling.
    - b. Application time (77° F - 50% RH): 1 hour.
    - c. Tack-Free Time: 4 hours.
    - d. Linear Shrinkage: Negligible.
    - e. Shore Hardness: Shore A 20 ± 5.
    - f. Tensile Strength: 125 - 200 psi.
    - g. Elongation: 500%.
    - h. Peel Adhesion (ASTM C794): 20 lb./in. min.
  - 3. Accessories:
    - a. Primers: Primer shall be selected based on joint sealant manufacturer's recommendation.
- ). Cement shall be portland cement of the same type and source as was used in the original (parent) concrete.

B. Water used shall be potable.

C. Aggregate shall conform to ASTM C33.

1. The fine aggregate shall be clean, sharp, well graded siliceous sand meeting the following detailed requirements:

Organic Matter	Plate 2 maximum
Silt	2.0% maximum
Soundness	5% maximum loss by 5 cycle magnesium sulfate test

<u>Sieve</u>	<u>Coarse Sand for Patches</u>	<u>Fine Sand for Surface</u>
#4	0-5%	0%
8	10-20	0-5
16	20-40	0-40
30	40-70	30-65
50	70-85	86-85
<u>100</u>	<u>93-97</u>	<u>85-100</u>
F.M.	2.8+.20	2.25+.20

2. Coarse aggregate shall meet the following requirements:

Organic Matter	Plate 1 maximum
Silt	0.8% maximum
Soundness	5% maximum loss by 5 cycle magnesium sulfate test
Fineness Modulus	Pea Gravel 5.4-5.6 3/4" Gravel 6.6-6.9

- D. No accelerating admixtures shall be employed in surface treatment. The use of Master Builders Co. Omicron Mortarproofing, or approved equal, shall be utilized (in accordance with the manufacturer's directions) to reduce shrinkage and improve durability of the 1:1 1/2 mixture. WRDA shall be used in any concrete patch (in accordance with manufacturer's directions).

### PART 3 - EXECUTION

#### 3.01 GENERAL

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- A. Concrete Surface Cleaning: Clean surface and all exposed faces of existing concrete pond liner of all dirt, dust, and debris.
- B. Existing Condition Survey: The Contractor shall notify the Owner's Representative after the entire surface area of the concrete pond liner has been cleaned of all dirt, dust, and debris. The Owner's Representative will then perform a condition survey of the existing concrete liner to determine the required repairs, location of repairs, and estimated quantity of repairs to be performed.
- C. Except as otherwise indicated, in all locations where new concrete repair material is to be deposited against existing concrete, a 24 hour bonding compound shall be applied to the surfaces of the existing concrete prior to placement of new concrete.
- D. In all cases where the joint between new concrete and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the limit of concrete removal shall be defined by a 1/2-in deep saw cut, or as specified otherwise within this specification herein, on each exposed surface of the existing concrete.
- E. When the finished surface is not specified to be coated, the color of new concrete in the exposed surfaces shall match the color of the existing adjoining concrete as closely as possible.
- F. The surface exposed shall be roughened by chipping, sandblasting, scarifying or other appropriate means before applying bonding compounds, or repair material as specified.
- G. The Engineer may from time to time direct the Contractor to make repairs to existing concrete; these repairs shall be made as specified herein.
- H. All commercial products specified in this Section shall be stored, mixed and applied in strict accordance with the manufacturer's recommendations.

### 3.02 CONCRETE REMOVAL FOR REPAIRS

- A. Where indicated or specified, existing concrete shall be removed to the depth indicated or required to expose sound concrete.
- B. Use only light air hammers up to 15 lbs, power saws, or hydrodemolition, unless otherwise shown or specified herein. Hammers larger than 15 lbs. shall only be used with prior approval from the Owners Representative.

### 3.03 CONCRETE SURFACE PREPARATION FOR REPAIRS

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- A. General: After removal of concrete to the specified limits, clean the surface to which the repair material is to be applied of all dust, debris, and laitance. Perform final cleaning prior to placement of the repair material. Unless otherwise specified, pre-wet the existing concrete surfaces prior to placing any new concrete repair material. The surface shall be saturated surface-dry with no standing water on the surface upon which concrete is to be placed. Use potable water for all cleaning operations.
- B. Final Surface Cleaning: Use abrasive blasting or high pressure water blasting to remove residual dust, debris, fractured concrete, and laitance. If dust is still present after blasting, blowing with oil-free compressed air or vacuuming shall be used to remove the dust.
- C. The final surface texture shall be rough, with approximately a 1/4 inch amplitude. Perform additional mechanical or abrasive surface preparation to achieve the specified final surface texture.

#### 3.04 PARTIAL DEPTH REPAIRS

- A. General: After final surface preparation and cleaning has been completed, verify that the surfaces to receive the repair are in a saturated surface dry condition with no standing water. Apply bonding agent as recommended by the manufacturer of the repair material to be used. Mix all materials in accordance with the manufacturer's recommendations. Cure all materials in accordance with the manufacturer's recommendations or a minimum of 7 days.
- B. After completely filling the prepared cavity with polymer-modified repair material, consolidate the repair material using a vibrating screed or internal vibrator. Screed and float the repair material after consolidating is complete. Allow the repair material to set to desired stiffness then apply a trowel finish.
- C. Partial depth repairs less than 1-inch in depth shall be repaired with polymer-modified mortar. Partial depth repairs greater than 1-inch in depth, shall be made with polymer-modified concrete.
- D. Place polymer-modified mortar in layers not exceeding 1-inch. Place polymer-modified concrete in layers not exceeding the lesser of either the manufacturers recommendation or 4-inches.
- E. Moist cure with wet burlap and polyethylene, a fine mist of water, or a water-based curing compound as recommended by the polymer-modified mortar and concrete manufacturer.

#### 3.05 FULL DEPTH REPAIRS

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- A. General: After final surface preparation and cleaning has been completed, verify that the surfaces to receive the repair are in a saturated surface dry condition with no standing water. Apply bonding agent as recommended by the manufacturer of the repair material to be used. Mix all materials in accordance with the manufacturer's recommendations. Cure all materials in accordance with the manufacturer's recommendations or a minimum of 7 days.
- B. Full depth repairs shall be made with polymer-modified concrete.
- C. After completely filling the prepared cavity with polymer-modified concrete, consolidate using a vibrating screed or internal vibrator. Screed and float the concrete after consolidating is complete. Allow the concrete to set to desired stiffness then apply a trowel finish.
- D. Moist cure with wet burlap and polyethylene, a fine mist of water, or a water-based curing compound as recommended by the polymer-modified concrete manufacturer.

### 3.06 CRACK REPAIR – ROUTING AND SEALING

- A. Surface Preparation: Prepare a groove at the surface of the crack using a concrete saw, hand tools or pneumatic tools to a depth of ¼ inch to ½ inch. Clean prepared groove by air-blasting, sandblasting, or waterblasting. Allow surface to dry before installing joint material.
- B. Install joint sealant per manufacturer's recommendations. Tool the joint sealant flush with adjacent finished surface. Clean up any excess joint sealant material.
- C. Allow joint sealant to cure in accordance with the manufacturer's recommendations.

### 3.07 CRACK REPAIR – GRAVITY FILLING

- A. Surface Preparation: Clean concrete surfaces that are contaminated with oil, grease, or dirt prior to beginning surface preparation in the area. Use only detergents or other proprietary cleaners formulated for removal contaminants from concrete, and use them in accordance with the manufacturers recommendations. Do not use solvents for the removal of oil or grease. Remove all traces of cleaning agents from the surface and cracks. Perform final surface cleaning immediately prior to application of gravity filling. Dry surfaces to receive repair material as recommended by the manufacturer.
- B. Applying Sealer: Apply high molecular weight methacrylate sealer to prepared surfaces in accordance with manufacturers recommendations. Remove excess sealer, leaving no visible surface film. Fill cracks greater than 1/8-inch wide in accordance with sealer manufacturers recommendations. Apply a second treatment of sealer evenly over the cracks and remove excess sealer on the surface. Cover with a light broadcast of a dry masonry sand. Distribute evenly over the surface at a rate recommended by the sealer manufacturer. After a curing period of 12 hours at 73 degrees F, remove any loose sand by lightly brooming.

### 3.08 CRACK REPAIR – INJECTION GROUTING

- A. Preparation: Clean each crack of dust, dirt, loose concrete and unsound material by vacuuming or flushing with water and allowing to dry, to remove free water in the crack. Insert a valve at both ends of each crack, at the junction of two cracks, and along the length of each crack at 16 to 20-inch intervals. Fill cracks between valves with crack surface sealer.
- B. Injection: After crack surface sealer has hardened and cured, pump [epoxy injection adhesive] [polyurethane injection adhesive] [ultra-fine cement grout] into valve at one end of the crack. For vertical surfaces start at the lowest valve and work upwards. As crack sealer appears at next valve, pinch pumping valve closed and move to next valve and commence pumping. Continue procedure until other end of crack is reached. Avoid delays in pumping operation. After crack sealer has hardened and cured grind valves off flush with concrete surface. Coat areas of valves with crack surface sealer and allow to harden and cure.

### 3.09 TEST FOR WATERTIGHTNESS:

- A. All concrete shall be watertight against leakage or groundwater infiltration. Special care shall be taken in the construction joints and any noticeable leakage or seepage causing wet spots on the concrete walls or slabs shall be repaired by and at the expense of the Contractor and by methods approved by the Engineer.
- B. All liquid holding concrete structures shall be tested for leakage before backfilling and after the concrete and repair materials have attained the specified minimum 28-day design strength, as indicated by test cylinders.
- C. The structure shall be filled with water to the design maximum water level or to 4-inches below any fixed overflow level, whichever is lower. The water shall be kept at the test level for 72 hours. After 72 hours, the liquid loss per 24 hour period shall be determined by measuring the vertical distance of the water surface from a fixed point within the concrete structure, or by an equivalent procedure approved by the Engineer. The test period shall last for 5 days.
- D. The change in water volume in the tank shall be calculated and corrected, as necessary, for evaporation, precipitation, and temperature. Temperature shall be recorded at a depth of 18-inches below the water surface. The water temperature, precipitation, and evaporation shall be recorded for each 24 hour period.
- E. The test measurements shall not be scheduled for a period when the forecast is for a substantial change to the weather pattern. The test shall also not be scheduled when the weather forecast indicates that the water surface would be frozen before the test is completed.

- F. For open structures designed to hold water, one tenth of one percent leakage will be allowed during a 24-hour period. If the leakage per 24-hour period exceeds the allowable, the structure shall be repaired and retested until the leakage falls within the allowable limit.
- E. The Contractor shall pay all costs (including water) incurred in the testing for watertightness.
- F. The Engineer shall be given a minimum notice of 48 hours prior to commencement of the leakage test.

#### PREPARATION:

- A. Damaged, cracked, spalled, or improper concrete shall be cut away to expose sound, virgin concrete surfaces. Edges of area to be repaired shall be cut square to a minimum depth of 3/4-inch so that there will be no feathered edges. Any reinforcing bars which have broken bond with the concrete shall have the concrete cut away all around and behind them so that the fingers of the hand can be inserted in the peripheral space between the rod and sound concrete. This will permit placement of repair concrete around the reinforcing bar and bonding same to bar and parent concrete.
- B. Install any additional reinforcing required by the Engineer. Repair or replace any damaged accessories or inserts in the damaged portion of the concrete.
- C. Wash all surfaces in the repair area free of dust and loose particles before placing forms for repair concrete.
- D. Prepare formwork for the void in the structure when the void is over 3 or 4 inches deep. The forms shall have one open (top) side which can be closed as the void is filled with repair concrete.

#### 3.02 APPLICATION:

- A. Premoisten the void area with water for at least 12 hours, to reduce absorption and provide a reservoir for moist curing at the interface of the repair. Remove "free" or glistening water. While the concrete is still damp, apply a 1/16-inch brush coat of neat cement slurry (mixed to the consistency of heavy paste) by means of bristle brushes to provide a bonding coat within any pits or cavity in the parent concrete; avoid coating large areas of the surface with the slurry.

- B. Before the slurry has dried or changed color, ram repair concrete into this portion of the formed void. The concrete shall comprise a crumbly, dry 1:1 1/2 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling") for small voids and a 1:1:1 1/2 mixture of cement, concrete sand and pea gravel (or 3/4-inch gravel) for larger voids. The dry-pack consistency of the concrete shall be zero slump, but moist enough so that when it is rodded and tamped until dense, an excess of paste will appear on the surface in the form of a spiderweb. Trowel it smooth with heavy pressure.
- C. In the case of unformed voids, don't build-up the repair to a point where it will sag with the weight of the fresh mortar or concrete.
- D. Employ the same source of cement and sand as was used in the parent concrete. Adjust color if necessary by the addition of proper amounts of white cement and/or limestone screenings. Moist-cure overnight.

### 3.03 REPAIR OF PITS AND BLEMISHES:

- A. The day after the application, remove the forms and any remaining or objectionable fins. While the concrete is still damp, apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within any pits or blemishes in the parent concrete. Before the slurry has dried or changed color, apply similar dry (almost crumbly) grout comprising one volume cement to 1-1/2 volumes of clean sand. This grout can be more uniformly applied by means of damp (neither dripping wet nor dry) pads of coarse burlap approximately 6 inches square used as a float. The grout should be well scrubbed into the pits to provide a dense mortar in the imperfections to be patched.
- B. Allow the mortar to partially harden from one to two hours, depending upon the weather. Avoid direct, hot sunlight. If the air is hot and dry, keep the concrete damp during this period using a fine, fog spray.
- C. When the grout has hardened sufficiently, cut off all that can be removed with a trowel. Next, allow the surface to dry and rub it vigorously with clean dry burlap to completely remove any dried grout. There should be no visible film of grout remaining after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Never leave any grout on the concrete overnight. Be sure to allow sufficient time for the grout to dry after it has been cut with the trowel so it can be wiped off clean with the burlap. This process removes slight discolorations and stains and gives a uniformly good appearance without the effect of a paint coating.

### 3.04 FINISHING:

On the day following the repair of pits and blemishes, the concrete again should be wiped off clean with dry burlap to remove any dust. At this time it may be helpful to employ a used piece of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment there should be no built-up film remaining on the parent surface. If such a film is present, a fine abrasive stone may be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing should be light and sufficient only to remove excess material without working up a lather of mortar or change the texture of the concrete. A thorough washdown with stiff bristle brushes should follow the final bagging or stoning operation in order that no extraneous materials remain on the surface of the concrete.

### 3.05 CURING:

Moist cure for 7 days by keeping repair concrete and adjacent parent concrete in a continuously damp condition. This may be accomplished by covering with a "poultice" of damp flannel and polyethylene taped to the concrete, being careful not to wash-out the patch..

END OF SECTION

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## **SECTION 01330**

### **SUBMITTALS**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. The work to be performed under this Section shall include the compilation and submittal of all required shop drawings, manufacturer's cuts, specifications, and certifications of all materials and equipment for the Engineer's approval. Actual product samples may also be required as stipulated in the technical specifications sections.
- b. All submittals shall be submitted in six (6) copies within four (4) weeks after the award of the contract, and shall be in not more than three (3) submittal packages so that a manual can be prepared for office and field reference. Alternatively, submittals may be made and distributed digitally with the approval of the Owner via email or File Transfer Protocol (FTP) site.

#### **PART II - SUBMITTALS**

##### **2.01 REQUIREMENTS**

- a. References are made throughout the specifications where submittals are required. All finishes, colors, and patterns are to be reviewed and approved by submittal or field sample.
- b. Where the Contractor's intention is to furnish the materials or equipment as specified, a list of all such elements, by Specification section, shall accompany the submittals so that the entire submittal is complete for the project.

#### **PART III - EXECUTION**

- 3.01 Submit all documents and data in a collated, manual format, with six (6) manuals to be submitted. Include a Table of Contents of the material for reference. The submittal is to be entire and complete, addressing all furnishings and installation.
- 3.02 Submit all required product or material samples concurrent with the materials/equipment information manuals described above. Each submittal shall reference its appropriate specification section, part and paragraph.

**- - - END OF SECTION - - -**

## SECTION 01350

### PERMITS

#### PART I - GENERAL

##### 1.01 SCOPE OF WORK

- a. The Contractor shall be responsible for obtaining all permits required to complete the work of this contract, to provide all coordination and furnish all bonds, assurances and required warranties. As applicable, the Contractor shall be responsible for any/all fees associated with the securing of permits necessary for the execution of the work of this contract. Should any street work be required, an approved City contractor shall perform it.

##### 1.02 GENERAL REQUIREMENTS

A.

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#### Permits by Contractor

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Backflow Preventers

Trench Permit (520 CMR 14.00)(eff. date 3/1/09)

Electrical Permit

Plumbing Permit

(Contractor shall prepare permit application and obtain the permit after contract is awarded, bearing all expenses.)

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- B. The Contractor shall perform the work in accordance with the Contract Documents, including the attached permits/order of conditions, and any applicable municipal requirements.

##### 1.03 DIGSAFE

- a. Contact Digsafe seventy-two (72) hours prior to initiating work at telephone # 1-888-344-7233.

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## PART II - MATERIALS

- a. All materials and equipment shall conform to permit requirements and the City's standards for utilities, excavation, backfill, patching, and surveying or other work unless otherwise stated in these specifications. Coordinate as necessary with the appropriate City official and/or private utility.

### 3.01 EXECUTION

- a. Execute all work per permit requirements. All plumbing and electric work to be approved by City Inspectors, sidewalk ramps to be approved by City Engineer.

### 4.01 GUARANTEE

- a. Guarantee all work per permit requirements.

**- - - END OF SECTION - - -**



## **SECTION 01450**

### **SAMPLING & TESTING**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. The work under this Section shall consist of performing or ordering the work of collecting samples for testing, having tests performed by a Certified Testing Laboratory satisfactory to the Engineer, having all test results forwarded to the Engineer for approval, and paying all costs associated with the collection and sampling, transportation, shipping, postage, and testing, and the coordination of test results and approvals.

##### **1.02 SUBMITTALS**

- a. In accordance with Section 01330 of these Specifications, submit the names, addresses and certification of laboratories to be utilized for approval by the Engineer.

#### **PART II - MATERIALS**

##### **2.01 CONTAINERS AND TOOLS**

- a. Utilize tools recommended by the laboratory to obtain samples, packaging or containers suitable to, or furnished by, the laboratory, and collect all samples in the proper number and quantity to permit tests to be conducted.

##### **2.02 TESTS**

- a. Refer to Section specifications for test requirements and criteria for results; coordinate with the Owner's Representative.
- b. All irrigation systems, splash pad elements, play equipment, locking gates, lighting systems, and any other components from the scope of work as requested by the Owner's Representative shall be tested to ensure complete compliance with manufacturer's installation instructions and warranty requirements.

#### **PART III - EXECUTION**

##### **3.01 METHODOLOGY**

- a. Unless otherwise directed by the Section specifications, perform sampling and

testing will be ordered by the Contractor and approved by the Owner's Representative. Locations, number and quantity of samples shall be submitted for approval as directed in accordance with the Specifications.

- b. Sampling and Testing results must be provided to the Owner's Representative and Approved prior to the installation of any work potentially impacted by unacceptable test results.

### 3.02 PAYMENT

- a. Payment for all sampling and testing efforts shall be included in the lump sum contract price bid.

**--- END OF SECTION ---**

## SECTION 01570

### ENVIRONMENTAL PROTECTION

1. Description
2. Notification
3. Implementation
4. Area of Construction Activity
5. Protection of Water Resources
6. Construction in Areas Designated as Wetlands on the Drawings
67. Protecting and Minimizing Exposed Areas
78. Location of Storage Areas
89. Protection of Landscape
910. Clearing and Grubbing
101. Discharge of Dewatering Operations
112. Dust Control
123. Separation and Replacement of Topsoil
134. Baled Hay or Straw
145. Silt Fence
15. Noise Control
16. Surface Restoration of Cross Country Areas

1. Description

- A. The work covered by this section of the specifications consists of furnishing all labor, materials, tools and equipment and performing all work required for the prevention of environmental pollution during and as a result of construction operations under this contract.
- B. The requirements set forth in this section of the specifications apply to cross-country areas, river and stream crossings, and construction in and adjacent to wetlands, unless otherwise specifically stated.
- C. All work under this Contract shall be in accordance with the Conservation Commissions' Orders of Conditions as well as any conditional requirements applied, all of which are attached to Section 00890, PERMITS.

2. Notification

The ENGINEER will notify the CONTRACTOR Contractor in writing of any non-compliance with the foregoing provisions. The CONTRACTOR Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the CONTRACTOR Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the CONTRACTOR Contractor fails to act promptly, the ENGINEER may order stoppage of all or part of the work until satisfactory corrective action

has been taken. No claim for an extension of time or for excess costs or damage incurred by the CONTRACTOR Contractor as a result of time lost due to any stop work orders shall be made unless it was later determined that the CONTRACTOR Contractor was in compliance.

3. Implementation

- A. Prior to commencement of work, the CONTRACTOR Contractor shall meet with representatives of the ENGINEER to develop mutual understandings relative to compliance of the environmental protection program.
- B. B. The CONTRACTOR Contractor shall submit for approval six sets of details and literature fully describing environmental protection methods to be employed in carrying out construction activities within 100 feet of wetlands or across areas designated as wetlands.

4. Area of Construction Activity

Insofar as possible, the CONTRACTOR Contractor shall confine his construction activities to those areas defined by the Contract Drawings plans and Specifications. All land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction at least equal to that which that, which existed prior to work under this contract. The CONTRACTOR Contractor shall keep the active access driveway into the site from Lexington Street and from Parker Albion Street clear of debris, equipment and vehicles at all times for Fire Department access. All Contractor vehicles to be parked on the job site, unless authorized by City representative and Department of Traffic and Parking.

5. Protection of Water Resources

- A. The CONTRACTOR Contractor shall not pollute streams, lakes or reservoirs with fuels, oils, bitumens, calcium chloride, acids or other harmful materials. The CONTRACTOR shall also prevent the transport of soil, dirt, and salt to surface streams, wetlands, and/or catch basins. It is the CONTRACTOR Contractor's responsibility to comply with all applicable Federal, State, County and Municipal laws regarding pollution of rivers and streams.
- B. Special measures should be taken to insure against spillage of any pollutants into public waters, and run-off of demolition site sediments into stormwater collection systems. Measures shall include placement of haybales around catchbasins and along temporary construction fencing, as indicated on Drawing C-2SP-1 – Demolition Plan.

6. Construction in Areas Designated as Wetlands on the Drawings

- A. Insofar as possible, the Contractor shall make every effort to minimize disturbance within areas designated as wetlands. Total easement widths shall be limited to the widths shown.
- B. The Contractor shall perform his work in such a way that these areas are left in the condition existing prior to construction.
- C. The elevations of areas designated as wetlands shall not be unduly disturbed by the Contractor's operations outside of the trench limits. If such disturbance does occur, the Contractor shall take all measures necessary to return these areas to the elevations which existed prior to construction.
- D. In areas designated as wetlands, the Contractor shall carefully remove and stockpile the top 24 inches of soil. This topsoil material shall be used as backfill for the trench excavation top layer. The elevation of the trench shall be restored to the preconstruction elevations wherever disturbed by the Contractor's operation.
- E. The Contractor shall use a trench box, sheeting or bracing to support the excavation in areas designated as wetlands.
- F. Excavated materials shall not be permanently placed or temporarily stored in areas designated as wetlands. Temporary storage areas for excavated material shall be as directed by the Engineer.
- G. The use of a temporary gravel roadway to construct the pipeline in the wetlands area is not acceptable. The Contractor will be required to utilize timber or rubber matting to support his equipment in these areas. The timber or rubber matting shall be constructed in such a way that it is capable of supporting all equipment necessary to install the pipeline. The timber or rubber matting shall be constructed of materials and placed in such a way that when removed the material below the matting will not be unduly disturbed, mixed or compacted so as to adversely affect recovery of the existing plant life.
- H. Bentonite dams shall be placed in wetlands to prevent drainage. Locations for dams are as indicated on the drawings or as directed by the Engineer.
- I. During construction, easements within wetlands shall be lined with a continuous haybale/siltation fence barrier.

67. Protecting and Minimizing Exposed Areas

- A. The CONTRACTOR Contractor shall limit the area of land which is exposed and free from vegetation during construction. In areas where the period of exposure will be

greater than two (2) months, temporary vegetation, mulching or other protective measures shall be provided as specified.

- B. The CONTRACTOR Contractor shall take account of the conditions of the soil where temporary cover crop will be used to insure that materials used for temporary vegetation are adaptive to the sediment control. Materials to be used for temporary vegetation shall be approved by the ENGINEER.

78. Location of Storage Areas

- A. The location of the CONTRACTOR Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site or areas to be cleared as a part of this project, and shall require written approval of the ENGINEER. Plans showing storage facilities for equipment and materials shall be submitted for approval of the ENGINEER.
- B. No excavated materials or materials used in backfill operations shall be deposited within a minimum distance of one hundred (100) feet of any watercourse or any drainage facility. Adequate measures for erosion and sediment control such as the placement of baled hay or straw around the downstream perimeter of stockpiles shall be employed to protect any downstream areas from siltation.
- C. There shall be no storage of equipment or materials in areas designated on the Contract Drawings as the 100-foot wetlands buffer zone.
- D. The ENGINEER may designate a particular area or areas where the CONTRACTOR Contractor may store materials used in his operations. Temporary storage trailers shall be installed at Contractor's cost.
- E. Storage areas in cross-country locations shall be restored to pre-construction conditions with the planting of native species of trees and shrubs.

89. Protection of Landscape

- A. The CONTRACTOR Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without written authority from the OWNER. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorages unless specifically authorized by the ENGINEER. Excavating machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees which are not to be

removed, particularly overhanging branches and limbs. The CONTRACTOR Contractor shall, in any event, be responsible for any damage resulting from such use.

- B. Branches, limbs, and roots shall not be cut except by permission of the ENGINEER. All cutting shall be smoothly and neatly done without splitting or crushing. When there is unavoidable injury to branches, limbs and trunks of trees, the injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.
- C. Where, in the opinion of the ENGINEER, trees may possibly be defaced, bruised, injured, or otherwise damaged by the CONTRACTOR Contractor's equipment or by his blasting or other operations, the ENGINEER may direct the CONTRACTOR Contractor to adequately protect such trees by placing boards, planks, poles or fencing around them. Any trees or landscape feature scarred or damaged by the CONTRACTOR Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the expense of the CONTRACTOR Contractor. The ENGINEER will decide what method of restoration shall be used, and whether damaged trees shall be treated and healed or removed and disposed of under the provisions of Section 02230, CLEARING AND GRUBBING.
- D. Cultivated hedges, shrubs, and plants which could be injured by the CONTRACTOR Contractor's operations shall be protected by suitable means or shall be dug up, balled and temporarily replanted and maintained. After construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of a kind and quality at least equal to that existing at the start of the work.

#### 910. Clearing and Grubbing

- A. The Contractor shall clear and grub only on the Owner's land or the Owner's easements, and only the area required for demolition construction operations, as approved by the Engineer. Removal of mature trees (4 inches or greater DBH) will not be allowed on temporary easements.
- B. The Contractor shall not remove trees in the Owner's temporary easements without permission of the Engineer.

#### 101. Discharge of Dewatering Operations

**IMPROVEMENTS TO REEVES ELEMENTARY SCHOOL RESTORATION OF FARLOW PARK POND  
Woburn Newton, Massachusetts**

**01570-5**

**ENVIRONMENTAL PROTECTION 08/05/2002**

- A. Any water that is pumped and discharged from the trench and/or excavation as part of the CONTRACTOR Contractor's water handling shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- B. Under no circumstances shall the CONTRACTOR Contractor discharge water to the areas designated as wetlands. When constructing in a wetlands area, the Contractor shall discharge water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.
- C. C. The pumped water shall be filtered through baled hay, a vegetative filter strip or a vegetated channel to trap sediment occurring as a result of the construction operations. The vegetated channel shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.
- D. Contaminated dewatering effluent shall be handled, and if necessary, disposed of in accordance with applicable regulations and permits. Any required monitoring and analysis of the effluent shall be performed by the CONTRACTOR Contractor and the laboratory results shall be submitted to the ENGINEER.
- D.E. Water pumped or drained from excavations, water courses, or other structures encountered in the work shall be disposed of in strict compliance with pertinent federal, state and local environmental regulations. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the CONTRACTOR Contractor.

112. Dust Control

- A. During the progress of the work, the CONTRACTOR Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, to minimize creation and dispersion of dust. If the ENGINEER decides it is necessary to use calcium chloride for more effective dust control, the CONTRACTOR Contractor shall furnish and spread the material, as directed. Calcium chloride shall be as specified under Section 01562, DUST CONTROL. Dust control requirements shall be strictly enforced by the City
- B. Calcium Chloride shall not be used for dust control within a drainage basin or in the vicinity of any source of potable water.

123. Separation and Replacement of Topsoil

Topsoil shall be carefully removed from cross-country areas where excavations are to be made, and separately stored to be used again as directed. The topsoil shall be stored in an area



acceptable to the ENGINEER and adequate measures shall be employed to prevent erosion of said material.

134. Baled Hay or Straw

To trap sediment and to prevent sediment from clogging drainage systems, baled hay or straw shall be used where shown on the drawing C-2 – Demolition Plans. Care shall be taken to keep the bales from breaking apart. The bales should be securely staked to prevent overturning, flotation, or displacement. All deposited sediment shall be removed periodically. Hay bales shall not be placed within a waterway during construction of the pipeline crossing.

145. Silt Fence

- A. Where indicated on the drawings or where directed by the ENGINEER, the CONTRACTOR shall erect and maintain a temporary silt fence. In areas designated as wetlands, the CONTRACTOR shall line the limits of the construction easement with a silt fence. The silt fence shall be used specifically to contain sediment from runoff water and to minimize environmental damage caused by construction.
- B. The silt fence shall consist of a 3-foot wide continuous length sediment control fabric, stitched to a 22-foot wide, continuous length support netting, and stapled to preweathered oak posts installed as shown on the drawings. The oak posts shall be 1½-inches by 1½-inches (Minimum Dimension) by 48 inches and shall be tapered. The support netting shall be industrial strength polypropylene. The bottom edge of the sediment control fabric shall be buried as shown on the drawings. The sediment control fabric shall conform to the following properties:

<u>Property</u>	<u>Value</u>	<u>Test Method</u>
1. Grab Strength (lbs.)	124	ASTM D-4632
2. Elongation (%)	15%	ASTM D-4632
3. Puncture Strength (lbs.)	65	ASTM D-4833
4. Burst Strength (psi)	300	ASTM D-3786
5. Trapezoid Tear (lbs.)	60	ASTM D-4533
6. Equivalent Opening Size (U.S. Sieve)	No. 30	ASTM D-4571
7. Permittivity (sec <sup>-1</sup> )	0.10	ASTM D-4491
8. Water Flow Rate (gal/min/sf.)	10	ASTM D-4491
9. UV Resistance (%)	70	ASTM D-4355

- C. The silt fence shall be Mirafi Envirofence manufactured by Mirafi, Inc. or approved equal.

15. Noise Control

- A. The Contractor shall adhere to the City ordinances for Noise Control, (Article VII, Division 2), throughout the construction period. Noise control will be strictly enforced by the City.
- B. No construction shall occur between 7pm-7am Monday through Saturday, or any time on Sunday. Any exemption to prohibited construction hours must be authorized by a City representative.
- C. Contractor shall not permit engine idling on the job site. This shall be enforced through random, unannounced periodic inspections by City Officials.

16. Surface Restoration of Cross Country Areas

Plantings detailed in Section 02921 shall be conducted when construction of the pipeline has been completed within the areas designated. A one-year guarantee of maintenance will be required on these plantings to ensure that they establish in the area.

- - - END OF SECTION - - -

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SUMMARY OF CHANGES  
SECTION 01577 RODENT CONTROL

<u>DATE</u>	<u>DESCRIPTION</u>
11/28/95	New spec section originally prepared for Duxbury Snug Harbor sewer project (95098.1)
03/17/2000	Changed Section number to correspond with CSI Standards

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**ALBION PARK RESTORATION OF FARLOW PARK POND**  
Somerville/Newton, Massachusetts

**01577-1**  
**RODENT CONTROL**

03/17/2000

SECTION 01577

RODENT CONTROL

PART 1 - GENERAL

1.01 WORK INCLUDED:

- A. This section specifies requirements for rodent control activities by the Contractor at all work and laydown (or staging) areas in connection with this Contract.
- B. The Contractor shall retain the services of a licensed rodent exterminator to conduct an inspection of the work and laydown areas and report on the presence of rodents and take any necessary measures to eliminate existing rodent populations prior to start of work. All rodent control to be in place and approved prior to any equipment delivery or demolition.

1.02 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. Within ten days after Notice to Proceed, submit to the Engineer a written description of rodent control measures to be used and the areas to be included in the program.
- B. Provide the name and background of the licensed rodent exterminator retained to provide any necessary rodent eradication measures prior to start of work. The licensed rodent exterminator must be approved by City Director of Inspectional Services.

PART 2 - PRODUCTS

2.01 CONTAINERS:

Use metal or heavy-duty plastic refuse containers with tight-fitting lids for disposal of all garbage, or trash associated with food. These containers shall not have openings that allow access by rodents.

PART 3 - EXECUTION

3.01 WORK AND LAYDOWN AREAS WITHIN THE CONTRACT AREA:

- A. Before mobilization begins, obtain written verification from the rodent exterminator that rodent populations have been effectively controlled in areas to be occupied.

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**01577-2**  
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03/17/2000

- B. Following site clearing and before demolition, excavation, or construction, inspect work and laydown areas and remove all remaining trash, debris, and weeds.
- C. Maintain work and laydown areas free of trash, garbage, weeds, and debris. Provide and enforce proper use of refuse containers to ensure that rodents and other pests are not harbored or attracted.

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**ALBION PARK RESTORATION OF FARLOW PARK POND**  
Somerville/Newton, Massachusetts

**01577-3**  
**RODENT CONTROL**

03/17/2000

- D. Designate specific locations as lunch and coffee break areas to prevent random disposal of garbage and trash. Keep those areas free of litter and garbage, and provide refuse containers as described in 2.01 of this section. Keep refuse containers upright with their lids shut tight.
- E. Have all refuse containers emptied daily to maintain site sanitation.
- F. Notify the Engineer within 24 hours whenever rodents (rats or mice) or signs of rodent activity (burrows or droppings) are observed in work or laydown areas. Take appropriate action to locate and control the rodents.

3.02 LAYDOWN AREAS OUTSIDE THE CONTRACT AREA:

- A. Implement pest control at all laydown areas that are not areas of this Contract, but that are used by the Contractor in connection with this Contract. Undertake rodent control at least two weeks prior to use of the area and with time to ensure that the site is free of rodent populations (rats and mice) prior to site occupancy. Maintain the site free of rodents throughout the duration of its use.
- B. Clear laydown areas of trash, debris, and weeds prior to occupancy. Initiate those actions only after rodent populations have been effectively controlled.
- C. Maintain laydown areas free of trash, garbage, weeds, and debris. Provide and enforce proper use of refuse containers to ensure that rodents and other pests are not harbored or attracted.
- D. Dispose of all garbage or trash associated with food in refuse containers with tight-fitting lids as described in 2.01 of this Section. Have refuse containers emptied daily to maintain site sanitation.

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**ALBION PARK RESTORATION OF FARLOW PARK POND**  
Somerville/Newton, Massachusetts

**01577-4**  
**RODENT CONTROL**

03/17/2000

## **SECTION 01580**

### **PROJECT SIGN**

#### **PART I – GENERAL**

##### **1.01 SCOPE OF WORK**

- A. Provide all materials, labor, mountings and incidentals for one (1) temporary construction sign, four feet by eight feet (4' x 8'), installed in a location directed by the Owners Representative.

#### **PART II – MATERIALS**

##### **2.01 SIGN**

- A. Sign shall be made of durable, exterior plywood or metal, securely mounted to wood posts or attached to existing fencing, as directed by the Owner's Representative. Sign shall be professionally lettered. Wording and layout to be supplied by the Owner. Submit samples of color and a Shop Drawing indicating lettering layouts to Engineer for approval. Electronic file with sign layout to be provided to Contractor and Owner's representative by the Landscape Architect.
  - 1. One (1) sign shall be a project sign (or banner) and will include color renderings of the final park layout as well as the City Seal, 311 Logo and other pertinent information to be provided by the Owner's Representative. See example included herein.
- B. Sign shall be securely mounted with galvanized metal attachments and shall be framed so as to be durable. All attachments and mountings shall be child safe and vandal resistant. Should a project banner be provided, it may be securely attached to construction fencing.

#### **PART III – EXECUTION**

##### **3.01 PLACEMENT**

- A. Sign shall be installed facing the street or access point to the construction area so as to be visible and inform the general public. Where possible, the sign should be located so as not to conflict with the construction activity nor to require moving during the construction process.

- B. The construction sign shall be maintained in satisfactory condition during construction and then removed and disposed of legally by the Contractor just prior to the final acceptance of the work.

*Sample Project Sign Graphic*



--- END OF SECTION ---

**RESTORATION OF FARLOW PARK POND**  
Newton, Massachusetts

**01580-2**  
**PROJECT SIGN**



## SECTION 01720

### CONSTRUCTION LAYOUT

#### PART I - GENERAL

##### 1.01 SCOPE OF WORK

- a. The work under this section shall consist of field staking the horizontal and vertical alignment of all essential features and proposed work, including fields, courts, sidewalks, fencing, drainage, electrical and utility structures, plantings, and other related features as shown on the plans, by a registered Engineer or Land Surveyor. The Contractor shall familiarize himself with the existing conditions and shall be responsible for locating or re-establishing survey field ties, property lines, and benchmarks indicated on the plans.
- b. Existing survey tie information if available shall be provided by the City, or the Owner's Representative upon request.

##### 1.02 QUALIFICATIONS & SUBMITTALS

- a. The Contractor shall engage the services of a Professional Engineer or Land Surveyor Registered in the Commonwealth of Massachusetts and shall submit the name, address, and registration number of such person or persons to the Engineer in writing.
- b. Whenever reference is made on the plans or in these specifications to a Land Surveyor registered in the Commonwealth of Massachusetts, the Contractor may substitute a Registered Professional Engineer, except that only a Registered Land Surveyor will be permitted to conduct property line or boundary surveys.

#### PART II - MATERIALS

##### 2.01 LAYOUT AND STAKING

- a. The Contractor shall be responsible for furnishing all stakes, pins, and grade markings as required to implement the work of layout and staking and shall make all field adjustments ordered by the Engineer at no extra cost to the Owner.
- b. Upon request by the Engineer, the Contractor shall make available to the Owner survey instruments necessary to check the proposed vertical and horizontal alignments at no extra cost.

## PART III - EXECUTION

### 3.01 SURVEY LAYOUT

- a. The Contractor shall use the alignments shown on the plans to establish the layout of all proposed features and shall perform field adjustments as ordered by the Engineer.
- b. The Surveyor shall lay out the essential or necessary grades and locations of site furnishings, footings, pavements, utilities, structures and other proposed elements. The surveyor shall verify the location of any existing spikes, stakes, pipes, drill holes, etc. and shall be responsible for their accuracy. Proposed features shall be located in relation to dimensions shown on the drawings and as adjusted by the Engineer.
- c. The Contractor shall inform the Engineer when the general layout is completed and shall not begin excavation until the Engineer approves the various alignments. Any discrepancies encountered in field conditions shall be reported to the Engineer immediately and shall be adjusted as directed.
- d. The Contractor shall be responsible for maintaining the correct vertical and horizontal alignment of all elements, which responsibility shall not be waived by the Engineer's approval of basic layout and stakeout.

**- - - END OF SECTION - - -**

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## **SECTION 02220**

### **DEMOLITION**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. Work under this Section shall consist of the careful removal, storage for reuse, transportation off-site, or demolition, of all structures and site features encountered or noted to be removed or abandoned to three feet below finished grade, and the removal and disposal of all materials not called for to be reused or salvaged, in accordance with the contract drawings, these specifications, and the directions of the Engineer. Provide all labor, equipment, materials and transportation necessary to complete the work.
- b. Rodent control must be in place and approved by Owner's Representative prior to the start of demolition.
- c. Items plan referenced to be removed and stored shall be carefully removed and stored on site in a manner and location designated by the Engineer for reinstallation later as shown on the plans or as directed by the Engineer.
- d. Items plan referenced, or as directed by the Engineer to be removed and disposed of shall be removed from the site and properly and legally disposed of by the Contractor.
- e. Items indicated on the contract drawings or in the specifications to be removed and salvaged, or other items directed to be removed by the Engineer, shall be transported to a municipal storage facility, located within the City confines, and unloaded and stacked as directed by the Engineer.
- f. The following scope describes the general work/demolition requirements of this Section.
  1. Cement concrete and bituminous concrete pavements.
  2. Chain link fencing and footings complete.
  3. Play area edging and curbing.
  4. Other features as indicated on the drawings.

## 1.02 PROTECTION

- a. The Contractor shall assume complete responsibility and liability for the safety and structural integrity of all work and utilities to remain during demolition.
- b. Provide safeguards including, but not limited to, warning signs, barricades, temporary fences, warning lights and other items required for protection of personnel and the general public during performance of all work. Secure construction fence of 5' minimum height to be installed and maintained until park opening date.
- c. All features related to protection shall be maintained until that work has been completed to the point when such safeguards are no longer required.

## 1.03 SPECIAL REQUIREMENTS

- a. The Contractor shall salvage frames, grates, and covers not to be reused from any demolition work and transport these to the Franey Road Maintenance Yard unless these are called for to be reused or ordered by the Engineer to be disposed of.
- b. Install erosion controls to protect adjacent areas from eroded materials likely to enter wetlands, resource areas, or drainage ways/systems, downstream of areas disturbed by work activities.
- c. Where items to be demolished are located within or adjacent to pavements to remain, the Contractor shall make provisions to protect that pavement to remain. Cut concrete pavement back to score line and cut bituminous concrete pavement back far enough so as not to allow disturbance to base course materials. Pavements damaged as a result of Contractor activities shall be replaced to the extent determined by the Engineer at no additional cost to the Owner.
- d. Removal of pavement within dripline of trees to remain is required to be done by hand tools or an air spade.

## PART II - MATERIALS

### 2.01 BACKFILL

- a. The Contractor shall provide suitable backfill as specified under Section 02350 of these Specifications, to fill voids left by removal or abandonment of site features, and shall provide all pipe cap ends, mortar, brick and other material needed to cap off or plug pipes of various sizes and kinds.
- b. Suitable materials shall be used as base course fill and topsoil to the depth as

specified herein. Restore disturbed areas with similar materials blended to match the line and grades of adjacent surfaces.

### PART III - EXECUTION

#### 3.01 SALVAGEABLE MATERIAL

- a. Frames, grates and other salvageable material shall be carefully removed to minimize damage and stored for later reuse, transport, or removal from site.

#### 3.02 ABANDONED STRUCTURES

- a. All inlets and outlets shall be plugged with at least eight (8) inches of brick and mortar masonry. Upper portions of masonry structures shall be removed to a depth of three feet. The bottoms of all structures shall be broken to allow drainage, and the structure shall be filled with suitable backfill material placed in six (6) inch layers and thoroughly compacted at each level.
- b. The Engineer shall review work related to abandoned structures before backfilling. Those items not reviewed before backfilling shall be uncovered and backfill procedures observed, at no expense to the Owner.

#### 3.03 ABANDONED PIPES OR CONDUITS

- a. Plug previously abandoned drainpipes encountered with masonry brick at least eight (8) inches in thickness.
- b. Abandon discontinued water supplies that are encountered during the execution of this contract in accordance with BWSC requirements.
- c. Electrical conduits encountered and previously abandoned shall be capped or plugged.
- d. Notify Owner's Representative of location of abandoned pipes and conduits,

**- - - END OF SECTION - - -**

HISTORY OF CHANGES

SECTION 02222

ABANDONMENT OF SEWERS AND DRAINS

<u>Date</u>	<u>Changes</u>
03/17/2000	Changed Section number to correspond with CSI Standards
11/12/2001	Added to Connecticut Master Specs.
03/27/2003	Added text to address removal and disposal of manholes; added the use of controlled density fill for filling abandoned pipes greater than 12-inches in diameter.

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## SECTION 02222

### UTILITY ABANDONMENT OF SEWERS AND DRAINS

**Note to specifier: Controlled density fill is term used by Mass. Highway Dept, and may be called by another name in other states. If using this spec. in another state please consult with that state's Highway or Transportation Dept. specifications, if a master spec does not exist for that state. Section 02058 would also need to be revised.**

#### PART 1 - GENERAL

##### 1.01 WORK INCLUDED:

- A. A. This Section covers the abandonment, cutting/capping/plugging, termination and discontinuance of existing utilities within the limit of work as designated on the Contract Drawings and described herein, including: sewer, water, gas, and electrical utilities.
- A.B. The location of existing underground services and utilities shown on the Contract Drawings is based on available records. It is not warranted that all existing utilities and services are shown, nor that shown locations are correct. The Contractor shall be responsible for determining the location of existing utilities and having the utility companies locate their respective utilities on the ground prior to excavating. This Section covers the abandonment of sewers and drains through various means including furnishing, handling and installation of all concrete and masonry plugs; removal and disposal of manholes, and filling existing pipes with controlled density fill, as shown on the Drawings and specified herein. The Contractor shall coordinate utility termination work with the applicable utility companies to ensure services have been shutoff.
- C. B. The Contractor shall furnish all materials, tools, labor, and equipment to abandon, cut/cap/plug, terminate, and discontinue existing sewer utilities as specified herein. , combined sewers, and drains.
- D. Except where specifically noted otherwise, the Contractor shall protect sewer manholes, hydrants, and the existing stormwater collection system (catchbasins, drain manholes, piping, and culverts).

##### 1.02 REFERENCES:

The following standards form a part of this specification, as referenced:

American Society for Testing and Materials (ASTM)

ASTM C32 Specifications for Sewer and Manhole Brick (Made from Clay or shale).

1.023 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

The Contractor shall submit six sets of its plan for abandoning existing pipe, showing equipment, methods and materials. The plan shall be submitted to and reviewed by the Engineer before construction.

- A. The Contractor shall submit material specifications and shop drawings for all materials and equipment for abandoning existing utilities under this Section. The Contractor shall also submit details/plan for protecting utilities to be left in place. The specifications, shop drawings, details/plan shall be submitted to and reviewed by the Engineer prior to utility termination/protection work.
- B. Submit to the Engineer an As-Built Drawing showing locations of all utility abandonments/terminations. Horizontal locations shall be by survey location or a minimum of three swing ties to fixed structures to remain (hydrants, manholes, catch basins, etc.). The Contractor shall also indicate vertical location based on depth from existing grade. This As-Built Drawing will serve as the Owner's record of utility termination locations.

PART 2 - PRODUCTS

2.01 2.01 CAPPING MATERIALS:

- A. Cast Iron/Ductile Iron Piping - Caps shall be ductile iron and mechanical jointed with individually actuated wedges of same diameter of pipe. Caps are to be "Megalug" as manufactured by EBAA Iron Sales, Inc. or approved equal. Provide concrete thrust blocks.
- B. Asbestos-Concrete Piping – Capping shall be done by installing a transition coupling, a ductile iron nipple and a mechanical joint cap with retainer gland. Provide concrete thrust blocks.
- C. Sanitary Sewer - Concrete or masonry plugs shall be used.
- D. Copper, Iron Piping - Caps or plugs shall be permanent screwed or silver soldered cap fittings. Termination materials shall be of the same materials as the pipe.



## 2.02 CONCRETE AND MASONRY PLUGS:

### PLUGS:

- A. Plugs installed at the open ends of the pipe to be abandoned shall be 12-inch thick 3,000-psi cement concrete, or 8-inch thick brick masonry as directed. The pipes to be abandoned include all sewer, combined sewer, and drains as specified herein and as shown on the Contract Drawings.
- B. Precast cement concrete plugs that are used shall meet the requirements for 3,000 psi concrete and shall be free of cracks and spalls. Brick masonry plugs shall be made of brick meeting the requirements of ASTM C32, for grade SS, hard brick.
- C. Mortar shall be composed of portland cement, hydrated lime, and sand, and the volume of sand shall not exceed three times the sum of the volumes of cement and lime. The proportions of cement and lime shall be as directed and may vary from 1:1/4 for dense hard-burned brick to 1:3/4 for softer brick. In general, mortar for grade SS brick shall be mixed in the volume proportions of 1:1/2:4-1/2; portland cement to hydrated lime to sand. The cement concrete plug shall be covered with non-shrink grout to prevent leakage at the plug.

## 2.02 PIPE FILL:

- A. Fill used for the abandonment of sewers, combined sewers, and drains as shown on the drawings shall consist of clean fill, or controlled density fill meeting the requirements included in Section 02058 Controlled Density Fill.
- B. Any variance from the specified material shown on the plans or as specified herein for the abandonment of the pipeline shall be subject to the written approval of the Engineer.

## PART 3 - EXECUTION

### 3.01 3.01 INSTALLATION GENERAL:

- A. The Contractor shall determine the location of existing utilities to be abandoned from the Contract Drawings, field investigations, electronic utility detectors, coordination with applicable utility companies, and test pits.
- B. The Contractor shall at least 72 hours, exclusive of Saturdays, Sundays and holidays, prior to excavation contact DIGSAFE before working below ground and shall maintain the DIGSAFE numbers throughout the course of the project.

- C. The Contractor may not begin excavations until approval of the **Excavated Materials Management Plan (EMMP)** as **described in Section 02282**. Before backfilling any underground utility termination, the Contractor shall notify the Engineer so the Engineer can inspect and photograph the termination. If the area is covered prior to inspection/approval the work shall be uncovered for inspection at the Contractor's expense. Any and all costs associated with uncovering the work and damages resulting from such uncovering are the sole responsibility of the Contractor. Immediately following the Engineer's inspection/approval, test pits and excavations for utility cutting/capping/abandonment shall be backfilled and the surface restored and maintained in a manner satisfactory to the Engineer.. The Contractor shall stockpile excavated materials per Section **02282**.
- D. The Contractor shall abandon, cut/cap/plug, terminate, and discontinue individual building utility services as designated on the Contract Drawings and described in these Specifications. Except where specifically noted otherwise, the Contractor shall protect sewer manholes, hydrants, and the existing stormwater collection system (catchbasins, drain manholes, piping, and culverts) as designated on the Contract Drawings and described in these Specifications.
- E. All utility shut offs shall be coordinated with the Owner and applicable utility company. The Owner shall be responsible for any fees associated with the shut off of utilities. The Contractor shall obtain written authorization from the utility companies before shutting off or terminating any utility service, including terminating water and sewer service.
- F. The Contractor shall not remove underground piping except as necessary to terminate utilities.

### 3.02 UTILITY ABANDONMENT:

#### A. Sanitary Sewer System:

- 1. Existing sewers shall be cut and plugged with 3,000 psi concrete or with brick masonry, within the Limit of Work as shown on the Contract Drawings or as directed by the Engineer. Abandoned sewer branches that are connected to manholes that will remain shall be cut as shown on the Contract Drawings. The manhole shall be plugged at the abandoned sewer entrance, and the end of the severed sewer shall be plugged as shown on the Contract Drawings. Where the sewer main is in the paved roadway, sewer services that are designated to be cut shall be cut as close to the edge of pavement as possible. The Contractor shall not excavate in the paved roadway nor damage any road pavement. The Contractor shall repair all damaged pavement to the satisfaction of the Owner at no additional cost. Sewer mains shall be plugged before proceeding with demolition of the buildings.

2. For non-circular pipes, the largest interior cross sectional dimension shall govern in determining size of abandonment.
3. The Contractor shall protect all sewer manhole frames and covers within the limit of work unless indicated otherwise on the Contract Drawings or directed by the Engineer. When a manhole is indicated to be demolished, completely remove the structure and backfill with gravel borrow to bring the area to final grade. The Contractor shall patch any pavement damaged or removed during capping operations.
4. All sewer services to each building shall be plugged at all building drains at the housing unit floor slabs. At the housing unit floor slabs, the building drains shall be plugged with a minimum of 4 inches of minimum 3000 psi concrete. Concrete so used shall be installed according to the manufacturer's written instructions and shall be cured properly to minimize future degradation.
5. Plugs shall be of adequate strength to withstand the full soil and groundwater pressure but not less than 5 psi. Plugs and caps shall be watertight.
6. Open ends of sewer services less than 12 inches in diameter shall be plugged with the appropriate VC plugs or concrete plug as directed by the Engineer. Such plug shall be made watertight with an application around the plug of an approved watertight compound.
7. Masonry plugs shall be at least 8-inches thick and concrete plugs shall be at least 12-inches thick. Pipes entering a manhole or catch basin that are to be abandoned shall have a plug installed that is flush with the interior wall of the structure.

**B. Water Services:**

1. The Contractor shall terminate water services and water service headers as shown on the Contract Drawings. The Contractor shall locate, in the field, the water service lines/headers and service/header valves for each building. There buildings may have more than one service/header from the water main. Where such service lines and valves are shown on the Contract Drawings, the locations are not guaranteed. Water service lines/headers shall be disconnected at the water main by first closing the corporation stop or service header valve at the main, then removing the water service or header from the stop/valve and installing a threaded watertight cap on the stop or at the valve, as applicable, and installing a threaded watertight cap on the severed piping. The severed piping shall be abandoned in place. Where a corporation stop or a valve cannot be located, or where a complete shutoff cannot be made, a new valve shall be added to the service/header line within 2 feet of the main and then shut off and capped. The Contractor shall patch any pavement damaged or removed during capping

operations. The Contractor shall not close any valves that will shut off water service to buildings outside the work area without the prior written permission of the Owner.

2. Where active water lines are to be capped, restrained caps with thrust blocks shall be used.
3. All fire hydrants shall remain accessible and functional unless indicated otherwise on the Contract Drawings.

Water mains that shall have open ends plugged with concrete or brick and mortar to prevent the entrance of soil into the pipe after backfilling.

Water mains that shall have open ends plugged with concrete or brick and mortar to prevent the entrance of soil into the pipe after backfilling.

Water main to be abandoned shall be cut at its connection to a live main and physically disconnected. A watertight ductile iron cap with concrete backing shall be installed on the live main. If a gate valve or corporation stop exists at the connection, it shall be closed.

4. Valve boxes shall be removed from all valves and curb stops which are on the abandoned main.
5. Plugs and caps shall be watertight. Metallic pipe shall be capped with caps of the same material as the pipe.

A. PLUGS:

1. Existing sewers or drains shall be plugged with 3,000 psi concrete or with brick masonry, as directed by the Engineer. For non-circular pipes, the largest interior cross sectional dimension shall govern in determining size of abandonment.
2. Plugs shall be of adequate strength to withstand the full soil and groundwater pressure but not less than 5 psi.
3. Open ends of sewer and drain services less than 12 inches in diameter shall be plugged with the appropriate VC plugs or concrete plug as directed by the Engineer. Such plug shall be made watertight with an application around the plug of an approved watertight compound.
4. Masonry plugs shall be at least 8-inches thick and concrete plugs shall be at least 12-inches thick. Pipes entering a manhole or catch basin that are to be abandoned shall have a plug installed that is flush with the interior wall of the structure.

C. Electrical Service:

1. The disconnection of electrical utilities to be done by others. Scheduling of disconnection will require coordination between Contractor and Owner. Contractor shall remove all dropped wires within the limit of work, unless noted otherwise, and dispose of them in compliance with current local, State, and Federal Regulations.

B. PIPE FILL:

1. Existing sewers or drains 12-inches and larger shall be abandoned and filled with clean fill, or controlled density fill, and plugged, as shown on the Drawings.
2. Existing sewers or drains smaller than 12-inches shall be plugged and abandoned but need not be filled with clean fill or any other material unless otherwise specified by the Engineer.
3. The method of filling the abandoned pipeline shall fill a minimum of 95 percent of the total annular volume of the pipe.

2. The Owner will arrange to have the electrical services terminated at main utility poles. The Contractor shall remove and dispose of all wire and electrical appurtenances that are abandoned, including abandoned utility poles between active utility poles and the buildings street. The Contractor shall not remove any transformers or any active utility poles. The Contractor shall coordinate with the Owner before handling any utility poles, electrical wiring, and appurtenances.

D. Gas Service:

1. The Owner will arrange to have the gas company disconnect gas service to the buildings and remove exterior gas appurtenances. **The local Gas Company shall remove individual gas services to each building.** The Contractor shall coordinate the abandonment of gas utilities with Owner to assure that the gas has been disconnected. The Contractor is responsible for the protection of gas mains during the demolition work, and ensuring that the connections to each building have been removed and plugged at the main by the Gas Company. The Contractor shall remove and dispose of all interior gas piping and appurtenances, **and all appurtenances remaining outside the building.** The Contractor shall also remove remaining above grade gas piping to the point where the piping turns horizontal underground.

E. Telephone:

1. The Contractor shall arrange with the telephone provider to have telephone services to each building disconnected at the pole. The Contractor shall remove and dispose of all abandoned wiring and appurtenances. The Contractor shall coordinate with the Owner before arranging to have telephone service disconnected.

F. Cable:

1. The Contractor shall arrange with the cable provider to have cable services to each building disconnected at the pole. The Contractor shall remove and dispose of all abandoned cable wiring and appurtenances. The Contractor shall coordinate with the Owner before arranging to have cable services disconnected.

CASTINGS.

All frames, grates and covers on existing manholes that are specified to be abandoned shall become the property of the Contractor remain the property of the Owner and shall be delivered to the Franey Road Yard.

3.02 REMOVAL AND DISPOSAL OF MANHOLES

REMOVAL OF MANHOLES

1. Frames and covers will be removed and delivered to the place designated by the Owner.
2. After filling the pipes to be abandoned that are enter the manhole as specified above, the Contractor shall remove the cone section of a precast manhole or the top four feet of brick in a brick manhole.
3. The Contractor shall place and compact clean fill in the void left by the removal of the manhole.
4. The ground or paved surface shall be restored in accordance with the drawings.

DISPOSAL OF MANHOLES

1. The Contractor shall dispose of all manhole materials that are to be removed. Unless the Owner designates a site for receiving the removed materials, the Contractor shall dispose of the materials at a site of his own choosing.

3.03 CONCRETE PLACING DURING COLD WEATHER:

- A. Concrete shall not be placed on frozen ground, and no frozen material or material containing ice shall be used. Materials for concrete shall be heated when temperature is below 40°F, or is expected to fall to below 40°F, within 73 hours, and the concrete after placing shall be protected by covering, heat, or both.
- B. All details of CONTRACTOR's handling and protecting of concrete during freezing weather shall be subject to the approval and direction of the ENGINEER. All procedures shall be in accordance with provisions of ACI 306.

3.04 CONCRETE PLACING DURING HOT WEATHER:

- A. Concrete just placed shall be protected from the direct rays of the sun and the forms and reinforcement just prior to placing, shall be sprinkled with cold water. The CONTRACTOR shall make every effort to minimize delays, which will result in excessive mixing of the concrete after arrival on the job.
- B. During periods of excessively hot weather (90°F or above), ingredients in the concrete shall be cooled insofar as possible and cold mixing water shall be used to maintain the temperature of the concrete at permissible levels all in accordance with the provisions of ACI 305. Any concrete with a temperature above 90°F, when ready for placement, will not be acceptable, and will be rejected.

END OF SECTION

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**0113/127/2003CEYLON STREET PARKALBION PARKRESTORATION OF FARLOW PARK POND  
BostonSomervilleNewton, Massachusetts1**

**02222-11**

**UTILITY ABANDONMENT-5**



## **SECTION 02235**

### **TREE PRUNING AND TREE AND STUMP REMOVALS**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. The work of this Section includes the following:
  - 1. Pruning - Class II, including the removal of all limbs necessary to execute the field, playground and fence work required under this contract.
  - 2. Removal of trees and stumps.
- b. Refer to the Contract Drawings for general location of trees along the site perimeter. In general, all trees are to remain and be pruned in conformance with this Specification. Tree removals shall be limited to the area denoted on the plans and shall include the removal of individual trees that would impede the construction of proposed facilities.

##### **1.02 QUALIFICATIONS OF CONTRACTOR**

- a. This work shall be limited to individuals, partnerships and corporations who are actively engaged in the field of Arboriculture, and who demonstrate competence, experience and financial capability to carry out the terms of this project. The Owner may require proof of these qualifications.
- b. All work shall be conducted by qualified and trained personnel under the direct supervision of a Massachusetts Certified Arborist in the Contractor's employ.

##### **1.03 SPECIAL REQUIREMENTS**

- a. Dutch Elm diseased wood shall be disposed of in accordance with provisions of General Laws, Chapter 87, Section 5, and Chapter 132, Sections 8 and 11 as amended; and in accordance with any additional local regulations. All wood shall be removed from the site and be properly disposed of in accordance with state and local regulations.
- b. No burning shall be permitted on the project site.

- c. Prior to commencing work, the Contractor shall submit a plan to the Owner for legal disposal of removed materials, in conformance with State and Federal regulations.

#### 1.04 STANDARDS AND DEFINITIONS

- a. All pruning work shall be performed in accordance with the following:
  - 1. The ANSI A300 ‘Standard Practices for Trees, Shrubs, and Other Wood Plant Materials’ of the Secretariat: National Arborist Association, Post Office Box 1094, Amherst, New Hampshire 03031.
  - 2. American National Standards Institute (ANSI) Standard Z-133.1.
  - 3. The standards and practices of the International Society of Arborists.
  - 4. The standards and practices of the Massachusetts Arborist Association.
  - 5. The standards and practices of the American Association of Nurserymen.
- b. The term ‘Owner’ shall mean the City of Somerville designated representative charged with carrying out the requirements of this Project – ‘Landscape Architect’, ‘Engineer’, ‘Planner’, or ‘Tree Warden’ as referenced herein, rendering approvals for the Owner.

#### 1.05 EXAMINATION OF SITE AND DOCUMENTS

- a. The Contractor shall be responsible for having a clear understanding of the existing site conditions and shall be responsible for fully carrying out the work of this Section, regardless of actual site conditions encountered.

#### 1.06 ORDER OF WORK

- a. Based on the site conference, the Contractor shall submit a schedule of work for the Owner’s review and approval prior to beginning work. Unless otherwise authorized by the Owner, failure of the Contractor to comply with the approved removal schedule shall be sufficient cause to give notice that the Contractor is in default of the contract.

#### 1.07 PROTECTION OF THE VEGETATION TO BE PRESERVED

- a. The Contractor shall protect all existing trees, shrubs, lawns and other site features designated to remain. The placement of protection devices, such as snow fence enclosures, shall, however, be at the Contractor's discretion.
- b. Damage no plant to remain by burning, pumping water, cutting of live roots or branches, or any other means. Neither vehicles nor equipment shall be parked within the dripline of trees to remain, or where ever damage may result to trees to be saved. Construction material shall not be stored beneath trees to be saved.
- c. The Contractor shall be liable for any damage to any trees, shrub, lawn or other site features to remain, and shall immediately report to the Owner. Damaged shrubs or lawns shall be restored or replaced to match existing to remain to the satisfaction of the Owner.
- d. The Contractor shall compensate the Owner for damages by installing replacement tree(s) of the size and species approved by the City and of sufficient quantity such that the sum of the Diameter at Breast Height (DBH) inches for replacement trees equals the total DBH inches of the damaged tree(s). Damaged shrubs shall be replaced with shrubs(s) of the same size, species, and quantity, unless determined otherwise by the Owner.

#### 1.08 USE AND CARE OF THE SITE

- a. The Contractor shall leave the work site at the end of each working period in a condition satisfactory to the Owner.
- b. Pavements shall be swept and lawns or other surfaces raked and/or otherwise cleaned of all material related to the work operation. Degree of clean-up required will be described by the Owner and will be based upon the character of the work area.
- c. All trimmings or any other form of debris (except diseased materials or trimmings from Elms) shall be collected and chipped. The Contractor shall remove all materials and shall dispose of such materials off site in a legal manner.
- d. No vehicles are to be stored on site. The Contractor shall be fully and solely responsible for any damage to equipment or vehicles left at the site of the work. All necessary permits shall be obtained by the Contractor.

## PART II - MATERIALS

### 2.01 EQUIPMENT

- a. Equipment necessary for this Contract shall be properly maintained and in good operating condition to the City's satisfaction. The Contractor shall promptly remove and replace any equipment which the Owner deems to be in unsatisfactory condition or otherwise unsuitable.
- b. Cutting tools shall be kept well sharpened to provide clean smooth cuts. Any tools utilized on any tree suspected to have cankers or other fungal, bacterial or viral diseases shall be sterilized or not used on any other specimen.
- c. A disc chipper shall be used which will process material up to twelve (12) inches in diameter.

### 2.03 PERSONNEL

- a. The Contractor shall submit each employee's name and title prior to the commencement of work. The Contractor shall advise the Owner of any changes in roster assigned to this Contract.
- b. The crew foreman shall have a minimum of five (5) years climbing/pruning experience. At least one (1) crew person shall be an MCA and shall be certified in CPR.
- c. Each trimmer shall be experienced and highly qualified with the necessary tree worker skills to successfully complete the work of this Section, including the ability and training to perform aerial rescue. Said skill shall also include worker safety and ability in compliance with current OSHA and ANSI Z-133.1 Standards.

## PART III - EXECUTION OF PRUNING/REMOVALS

### 3.01 PRUNING

- a. Under this Section, the Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the work in accordance with all local, state and federal regulations in force at the same time of this Contract and in accordance with tree pruning as specified herein.

- b. The work of this Section consists of all pruning work and related items as specified herein and includes, but is not limited to:
  - 1. Pruning - Class II throughout the designated areas and limb removal required to allow for the proper installation of all fields, play equipment and new fencing.

Class II pruning is defined as medium pruning and shall consist of the removal of dead, dying, diseased, interfering, objectionable and weak branches on the main trunks as well as those within the leaf area. An occasional branch one (1) inch or less in diameter may remain within the main leaf area where it is not practical to remove it.

### 3.02 DESCRIPTION OF PRUNING WORK

- a. Pruning and trimming are generally described as the removal and disposal of limbs, branches and stubs which are either dead, potentially detrimental to the health of the tree or dangerous to pedestrians, visually deficient, interfering or otherwise objectionable as determined by the Owner.
- b. The limits of all trees to be pruned have been identified on the plans or referenced elsewhere in this specification section.
- c. Vehicle access shall be controlled and approved by the City Representative.
- d. If the Contractor discovers tree(s) which have not been marked for pruning, but whose condition is such that removal is warranted, whether due to death, disease, decay, or structural weakness, such tree(s) shall not be pruned and the Contractor shall immediately report these findings in writing to the Owner and await the Owner's direction before proceeding with work on the particular tree(s) in question.
- e. All pruning shall be performed in a manner that maintains the natural aesthetic characteristics of the species and variety of trees. No topping or dehorning of trees or stubbing back of branches shall be permitted. All cuts shall be made to a lateral branch that is a minimum of one third (1/3) the size of the branch being removed, unless otherwise instructed by the Owner.
- f. The use of climbing spurs or spiked shoes shall not be permitted and their use will result in the immediate cancellation of the contract.

- g. All cuts shall be made sufficiently close to the parent stem so that wound closure can be readily started under normal conditions. Cuts shall, however, never be made through the branch collar. Slab cuts and rip cuts will result in cancellation of the contract.
- h. All limbs over two (2) inches in diameter to be removed shall be pre-cut to prevent splitting. Any branches that by falling would injure existing trees to remain or other objects shall be lowered to the ground by proper ropes.
- i. On trees known to be diseased and where there is known to be danger of transmitting the disease on tools, tools shall be disinfected with alcohol or bleach after each cut between trees.
- j. Lateral branches as well as occasional branch suckers (“water sprouts”) may be retained. Complete removal of secondary laterals and branch suckers resulting in the stripping of major limbs, (“lion tailing”) will not be permitted.
- k. Tree paint to seal pruning cuts shall not be used.
- l. All branches and limbs shall be manually lowered to the ground via rope and pulley. This practice must be consistent with the National Arborist Association Standards for Pruning. All grade-level artifacts and landscaping must be protected from damage.

### 3.03 REMOVALS

- a. The Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the removals work in accordance with all local, state, and federal regulations in force at the time of this contract and in accordance with tree and stump removals as specified herein.

### 3.04 DESCRIPTION OF REMOVAL WORK

- a. Removal is generally described as the removal of groups and individual trees and shrubs which interfere with the growth of more desirable types of trees; the clearing away of lesser growth that may obscure outstanding trees; and thinning out to provide space for healthy growth by the elimination of thinner, weaker trees.

- b. The Contractor shall adhere to the specifications and provide suitable facilities for inspecting the work. Failure of the Owner to immediately reject unsatisfactory work or to notify the Contractor of deviations from the specification shall not relieve the Contractor of responsibility to correct or remedy unsatisfactory work.
- c. The Contractor shall only work on trees designated by the Owner. No compensation will be made for work performed on any other tree or trees.
- d. Trees designated to be removed shall be taken down and all leaves, branches and trunks of trees properly disposed of by chipping and removal from the premises.
- e. Fell trees in a manner that allows all site features and those trees to be saved undamaged.
- f. Removal of all the parts of each tree shall be completed on the same day that the tree is cut.
- g. Stumps shall be ground to eighteen (18) inches below grade by grinding or other means acceptable to the Owner. The void from the stump removal operations shall be filled with ordinary borrow soil to within six (6) inches of finished grade. The top six (6) inches shall be filled with screened loam, moderately tamped to prevent future settling. In grass areas the disturbed area shall be sown with grass seed of a mix appropriate to the location, as directed by the Owner.
- h. Excavation or grading within the branch spread of trees to be saved shall be performed only under the direction of the Owner unless otherwise directed. Removal of pavement such as bituminous concrete in these zones shall be by hand tools and/or air spade to ensure root health for trees to remain.
- i. All equipment to be used and all work to be performed must be in full compliance with all standards as promulgated by OSHA at the time of bidding, including, but not limited to those regulations concerning noise levels, protective devices and operator safety.
- j. The Contractor shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall protect the public and its property from injury or damage that could be caused by the progress of the work. To this end the Contractor shall provide, erect, and maintain protective devices acceptable to the Owner, including but not limited to barricades, lights and warning signs.

- k. Any practice employed by the Contractor that is obviously hazardous as determined by the Owner shall be immediately discontinued by the Contractor upon receipt of either written or oral notice from the Owner to discontinue such practice.

- - - END OF SECTION - - -



## **SECTION 02350**

### **EXCAVATION, BORROW AND BACKFILL**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. Under this Section, the Contractor shall furnish all labor, materials, equipment and transportation required to complete Excavation, Borrow and Backfill work indicated on the drawings, as designated by the Owner's Representative, or as specified herein, to complete all proposed work.
- b. Without limiting the generality thereof, Excavation, Borrow and Backfill shall include excavating, furnishing borrow materials as necessary and back-filling for the construction of all proposed work from existing grades to finished grades. Work shall include the removal of unclassified material, such as bituminous pavements, curbs, ledge and boulders under one (1) cubic yard in size, concrete, reinforced and plain, structures, fencing of various types, and metal or wood posts; and unsuitable materials of every nature throughout the site within twelve (12) inches below finished subgrade elevations for proposed work; transportation of the excavated materials; back-filling to proposed base course subgrades with approved excavated and/or furnished materials; and the disposal of unsuitable, and/or surplus excavated materials.
- c. Work under this Section shall also include the discing and harrowing of existing grass or topsoil areas to break down all sod clumps and vegetation and the complete excavation, stockpiling, rehandling, spreading, and re-use (placing) of on-site topsoil in conformity with the lines, grades and dimensions shown on the plans. This material may be utilized where general embankment (not beneath pavements or structural improvements) is proposed. The Contractor shall take extreme care in the process of discing and harrowing of the existing topsoil to insure that subsoil to remain in place is not mixed with the topsoil. Disc compacted areas subject to construction traffic to the full depth of topsoil without mixing in subsoil.

- d. Work under this Section shall also include the excavation of existing base courses under existing pavement areas for re-use in proposed fill areas up to base course subgrades or loam borrow subgrades if the existing material is deemed suitable and is excavated without contamination by or mixing with unsuitable materials and subsoils. This material may be utilized for backfill over pipe cover in trenches only if all material over four (4) inches in size is removed prior to back filling. All existing materials shall be removed to the full depth of proposed work.
- e. Work under this Section shall also include the excavation of subsoil to the limit lines of proposed work. If deemed suitable by the Owner's Representative, as meeting the criteria or intent of paragraph 2.02 of this Specification, this material may be used as fill material for grading and general filling of any unpaved areas to bottom of proposed work. **No subsoil** shall be used for fill at proposed pavement areas or below proposed pipes or structures without meeting the requirements for paragraph 2.02a below.
- f. Work under this Section shall include the furnishing of all borrow materials required to complete the proposed work as designed. Where "processed gravel", "gravel borrow", or "gravel" is indicated in the specifications or on the drawings, only gravel conforming to this section of the specifications may be utilized.
- g. All topsoil/loam for sod, seed or plant material beds, whether re-used or furnished from off-site, shall conform to the loam borrow section of these Specifications.

## 1.02 REFERENCE STANDARDS AND SPECIFICATIONS

- a. References to specific standards, specifications and tests of the following technical societies, organizations, and governmental bodies may be made in the contract documents.
  - 1. AASHTO - American Association of State Highway and Transportation Officials (tests or specifications). AASHTO or AASHO
  - 2. ASTM - American Society for Testing and Materials.
  - 3. Mass. Standard Specs. - Latest edition of the Standard Specifications for Highways, Bridges (not waterways), Massachusetts Highway Department, hereinafter referred to as the "Massachusetts Standard Specifications."
  - 4. AWWA - American Waterworks Association.

## 1.03 SAMPLING AND TESTING

**RESTORATION OF FARLOW PARK POND**  
Newton, Massachusetts

02350-2

**EXCAVATION, BORROW & BACKFILL**

- a. Coordinate with Specification Section 01450.
- b. Four samples each of materials requested to be tested by the Owner's Representative shall be taken at the locations ordered by, and in the presence of, the Owner's Representative at the site or at the source of supply and under his direction for testing in accordance with requirements stated herein. The Contractor shall pay for these tests regardless of their results.
- c. Test results shall be submitted directly to the Owner's Representative by a Certified Testing Laboratory to be approved by the Owner's Representative. No material shall be re-used or furnished until the Owner's Representative's approval is given.
- d. All tests of any kind ordered by the Owner's Representative shall be paid for by the Contractor regardless of test results.

#### 1.04 SPECIAL REQUIREMENTS

- a. If test results indicate that existing base course materials are suitable backfill material per paragraph 2.02, they shall be utilized as fill up to subgrade and for trench backfill over pipe cover. If results indicate that they meet the specifications for gravel, they may be utilized where gravel is proposed.
- b. The sequence of all excavation operations shall be such as to insure the most efficient re-use of suitable excavated materials and the use of a minimum amount of specified borrow.
- c. The Contractor shall inform and satisfy himself as to the character, quantity, and distribution of all material to be excavated. No payment will be made for the placement of any excavated material that is used for purposes other than those designated and as specified herein. Further, these shall be removed at no cost to the Owner if so directed by the Owner's Representative.
- d. The Owner's Representative shall have final determination over the excavation, moving, placing and disposition of all materials, and shall determine the suitability of materials to be placed in excavated areas.
- e. All backfill to subgrade, shall be compacted to not less than ninety-five percent (95%) of the maximum dry density of the material as determined by the Standard AASHTO Test Designation T-180-86, Modified Proctor Test.

- f. Unsuitable and/or excess excavated materials shall be removed and properly disposed of in legal disposal areas off of the site at no additional cost to the Owner.
- g. Exploratory excavation to locate existing utilities or obstructions shall be at the Contractor's discretion to assist him in the work of this project and no extra payment shall be made for such verification. Although extra payment is not considered, lack of such payment does not constitute a waiver of the Contractor's responsibility to verify all utilities. The contractor must ensure verification of existing services and ensure the safety of the Contractor's work forces.
- h. No on-site excavated backfill materials may be used as base courses for any pavements or structural elements unless test results show these materials to meet this specification for the type of material to be utilized and are so approved by the Owner's Representative.

#### 1.05 SUBMITTALS/COORDINATION

- a. The Contractor, per Sections SUBMITTALS and SAMPLING AND TESTING of these Specifications shall furnish all necessary submittals and certifications as to Certified Testing Laboratory, disposal sites, etc.
- b. The Contractor shall notify Digsafe at 1-888-344-7233 at least seventy-two (72) hours prior to initiating excavation.
- c. Trench permit must be submitted prior to the beginning of any related excavation.

### PART II - MATERIALS

#### 2.01 BORROW MATERIALS

- a. Excavated topsoil and furnished topsoil to be utilized for sodding, seeding and landscaping must conform to Section 02910 Screened Loam in order to be used as Loam Borrow. Existing topsoil not passing tests for Loam Borrow may be considered suitable as general fill below subgrade, in landscaped areas only and may be utilized throughout the proposed sod and seeded areas, up to subgrades of proposed work.
- b. Gravel Borrow shall be as specified under paragraph 2.04 and shall be utilized whenever gravel is noted, including beneath pavements and structural elements unless otherwise noted. Gravel Borrow shall satisfy the requirements listed in MHD Specification Section M1.03.0, Type b. 3" largest dimension
- c. Although suitable excavated backfill materials and topsoil may be reused to fill to

subgrade as specified herein, if there are insufficient quantities of materials available the Contractor shall furnish Suitable Backfill as specified in paragraph 2.02a below.

- d. If approved by the Engineer, Suitable Backfill materials excavated from beneath pavements may be utilized as backfill from four (4) inches above the overt of pipes so long as all material over four (4) inches in size is removed from the material prior to backfilling and all trench compaction requirements may be met.
- d. Where Sand Borrow is required, materials shall conform to Section M1.04.1 of the Massachusetts Standard Specifications. Utilize Sand Borrow as necessary for pipe bedding and cover.
- e. Where Crushed Stone is required, materials shall conform to Section M2.01 of the Massachusetts Highway Standard Specifications. Utilize Crushed Stone as necessary for granite block setting beds, backfill for sub-drains, and other details as noted in contract documents.

2.02 SUITABLE BACKFILL

- a. All other materials to be placed where Specifications or Drawings call for "fill," "back-filling," or "filling" to subgrade, shall be natural soil, well-graded and free from all organic weak, compressible, and frozen materials, and shall contain no stone larger than four (4) inches in maximum dimension. It shall be of such nature and character that it can be dried and compacted and shall be free of all expansive materials (such as high plastic clays) and of materials subject to decay, decomposition, or dissolution, and shall conform to the following gradations:

<u>U.S. Sieve No.</u>	<u>Total Percent Passing by Weight</u>
4 inch	100
#4	20-75
#40	0-25
#200	0-5

- b. If, sufficient suitable fill material is not available from excavations under this Contract, to complete filling to subgrades as specified above, additional fill, as specified under paragraph 2.02a above, shall be furnished by the Contractor from other sources at no additional cost. Excavated material from the site, and furnished material for use as Suitable Backfill, shall be deemed suitable only if they meet the requirements of paragraph 2.02a above, can be properly compacted, and are satisfactory to the Owner’s Representative.
- c. Use Suitable Backfill compacted as specified for general grading as backfill

except as specified herein; fill to sub-grades of proposed work where shown.

2.03 CRUSHED STONE FOR TRENCHES (IN WATER ONLY)

- a. If trench excavations contain water, the Contractor shall substitute crushed stone, one and one-half (1-1/2) inch minus, for bedding and backfill, in accordance with MHD Standard Specifications M2.01.2, at no additional cost to the Owner, to three (3) inches above the standing water level; unless otherwise directed by the Owner's Representative.

2.04 GRAVEL BORROW

All references to "Processed Gravel, "Gravel Borrow", or "Gravel" shall conform to the following:

- a. All proposed gravel areas, utilizing salvaged or furnished materials shall conform to Section M1.03.0 Type "b", with maximum stone size two (2) inches in dimension, and Section 150 Embankment, of the Standard Specifications (MHD) shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials.
- b. Gradation requirements for gravel borrow shall be determined by AASHTO-T11 and T27 and shall conform to the following:

<u>Sieve</u>	<u>Percent Passing</u>
2"	100
1/2"	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

- c. Excavated materials from on-site may be utilized in all areas calling for gravel if they pass the test requirements for paragraph 2.04a above except that only stones above four (4) inches must be removed to reutilize the materials.

2.05 SAND BORROW

- a. The Sand Borrow shall consist of inert material that is hard durable coarse sand, free from loam, clay, roots, trash, frozen materials and other deleterious or organic materials. The sieve gradation requirements shall conform to the following:

Percent By Weight Passing

<u>Size of Sieve</u>	<u>Minimum</u>	<u>Maximum</u>
# 4	100	
# 16	55	80
# 50	10	25
#100	2	8
#200	0	2

PART III - EXECUTION

3.01 EXCAVATION AND FILLING

- a. Excavation and filling shall be executed to such depth that sufficient material will be left above the designated grade to allow for specified compaction to the required sub-grade. Should the Contractor, through negligence or other fault, excavate below the designated lines, he shall replace such excavation with approved materials, in an approved manner and condition, at his own expense.
- b. When the plans require excavation in areas in proximity to existing sidewalks, structures and utilities, it shall be the responsibility of the Contractor, at his own expense, to provide adequate and suitable drainage away from proposed work and existing features or use other satisfactory means and methods to protect and maintain the stability of such construction within or adjacent to the limits of work.
- c. Protect all existing trees, shrubs or other plan referenced features to remain. Hand excavate around all items to remain including tree roots or where utilities must be verified. Exposed tree roots shall be immediately covered with Loam Borrow in accordance with these specifications.

- d. No roots greater than two (2) inches in diameter shall be cut from trees to remain without approval of the Owner's Representative. Roots greater than one-half (1/2) inch in diameter that are cut or broken shall be promptly pruned to a smooth clean cut and painted with an approved compound.
- e. Any removal of existing facilities required in order to achieve the excavation to proceed, such as fences, walls, walkways, etc., shall be accomplished by the Contractor at no additional cost to the Owner. Restoration of these facilities shall be to a condition equal to that before removal, and safe and operational to the satisfaction of the Owner's Representative.
- f. Excavation shall be performed to the lines, grades, and elevations shown on the plans or as directed by the Owner's Representative, and shall be made in such a manner that the requirements for formation of the subgrade can be followed.
- g. No excavation shall be started until the Owner's Representative has reviewed and acknowledged the area of proposed construction. All material encountered, of whatever nature within the limits indicated, shall be removed and disposed of as directed. During the process of excavation, the grade shall be maintained in such condition that it will be well drained at all times.
- h. The planes at the bottom of the excavation (in cut), or the top of the fill, when completed, shall be known as the subgrade, and shall be true to the lines, grades and cross section shown on the plans, to allow proposed work (base courses and finished courses) to be completed.
- i. Hardpan, loose rock, boulders or other material unsatisfactory for subgrades shall be excavated to a depth as the Owner's Representative may direct below the contemplated subgrade. Muck, peat, matted roots or other yielding material unsatisfactory for subgrade foundation shall be removed to such depth as directed to provide a satisfactory foundation. Unsatisfactory materials shall be disposed of by the Contractor. The portion so excavated shall be refilled with suitable backfill as specified, furnished or obtained from the grading operations, or gravel borrow, as directed, and thoroughly compacted. Such excavation and filling beyond the limits called for on the plans shall be considered extra work and shall be processed accordingly. Solid ledge (not able to be removed by machine) or boulders (over 1 c.y.) encountered within the proposed work lines shall be removed as directed by the Owner's Representative and shall be considered extra work and processed accordingly. Clean off overburden for measurement by the Owner's Representative and do not proceed without the written approval of the Owner's Representative. Cross sections shall be taken and reviewed by the Owner's Representative for quantity approval.



- j. The removal of existing structures and utilities required to permit the orderly prosecution of the work shall be accomplished by the Contractor as directed and under this Section, unless otherwise shown on the plans. All existing foundations and structures shall be excavated to at least three (3) feet below the bottom of the proposed subgrade and the material properly disposed of off site. All such excavations shall be back-filled with Suitable Backfill and compacted. Floors of structures to be abandoned shall be broken, to ensure drainage, at no additional cost.
- k. All unsuitable excavated material shall be legally disposed of outside of, and away from, the project limits. All suitable excavated material deemed surplus by the Owner's Representative shall become the property of the Contractor and shall be properly removed from the site.
- l. The subgrade under areas to be paved shall be brought to proper line and grade by excavating and/or placement of compacted fill with suitable excavated material or gravel borrow as specified herein. Where filling is not required, the undisturbed subgrade shall be compacted according to the requirements stated herein.
- m. Fills to subgrade level shall be formed of successive layers not exceeding lifts six (6) inches in depth and each layer shall be compacted to not less than 95 percent of maximum dry density of the material as determined by the standard AASHTO Test Designation T-180-86, Modified Proctor Test. Testing shall be done a minimum of 50 feet on center through out the site where pavements are proposed.
- n. No additional payment will be made for materials removed, manipulated or replaced by the Contractor in order to obtain the specified density. Any removal, manipulation, aerating, replacement and re-compaction of materials necessary to obtain the required density shall be considered as incidental to the excavation and compaction operations and shall be performed by the Contractor at no additional cost.
- o. Topsoil excavation and rehandling shall consist of discing and harrowing grassed and existing topsoil areas at ninety (90) degrees to each prior operation to minimum 12" depth or as specified by Owner's Representative, and removing topsoil from all areas of proposed work and placing and grading the topsoil in embankment areas. Topsoil encountered below subgrade shall remain in place unless new paving is to be placed thereon and only as directed by the Owner's Representative. Then, such topsoil shall be excavated and rehandled, replaced with Suitable Backfill materials or gravel borrow and compacted as herein specified or as directed by the Owner's Representative.

- p. All areas exhibiting grass or weed growth shall be tilled by disc/harrow or rototilled in two directions to completely break up sod clumps prior to stripping the topsoil, and shall be stored in stockpiles if necessary to ensure organic matter decomposition. Such on-site stockpiled materials must be tested prior to reuse, and treated to prevent weed growth.
- q. After the areas to receive loam borrow or skinned infield (if required) mix have been brought to subgrade, and immediately prior to placing and spreading such material, the subgrade shall be loosened by discing or rototilling to a depth of at least three inches to permit bonding of the finished material to the subgrade material. Then place and spread the loam borrow or skinned infield material to the depths required by the Drawings to establish finish grades. Refer to Screened Loam Specifications and Skinned Infield Mix Specifications (as applicable).
- r. Protect all existing areas against damage due to the work under this Contract, and perform all repair and replacement work to any such areas which are damaged hereunder.
- s. Perform all excavation and back-filling required for the installation of subdrains, utility structures, and utility lines, and appurtenances required to the lines and grades shown on the Contract Drawings and as directed by the Owner's Representative.
- t. No extra work shall be initiated without notification of the Owner's Representative in writing, and the written approval of the Owner's Representative in response.
- u. The Contractor shall be responsible for any and all pumping or bailing necessary to complete his operations, and to keep all areas sufficiently dry to guarantee compaction in accordance with paragraph 3.01m. above.
- v. Sawcut, with approved diamond-blade cutting device, at lines of all pavements to remain. Mark out prior to cutting for Owner's Representative's approval.
- w. Where insufficient suitable materials of any kind exist on site for incorporation into the proposed work within proposed work lines, the Contractor shall furnish materials from off site, as necessary and in accordance with these specifications, at no additional cost to the Owner.

### 3.02 DRAINAGE AND DEWATERING

- a. Upon entering the premises, the Contractor shall assume responsibility for site and surface drainage of all areas affected by his work and shall maintain such drainage during the life of his Contract in a manner acceptable to the Official, at all times

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**EXCAVATION, BORROW & BACKFILL**

- protecting and maintaining the existing conditions in adjacent areas.
- b. Legally remove by pumping, draining or bailing all water that may accumulate or be found on the site within the contract limits where excavation and grading are to be done. Excavate and form all pump wells, sumps, dams, flumes or other necessary work to keep excavations entirely clear of water. Newly made and existing concrete and masonry shall be protected from injury resulting from dewatering work by the use of canvas, tar paper or by such other sufficient method. Maintain at all times upon the work sufficient and satisfactory pumping machinery, including standby equipment. Provide pump wells or well points and underdrains as may be required, where needed to properly handle the water. Maintain excavations free from water until date of acceptance of the project by the Owner.
  - c. Water from excavations shall be disposed of in such a manner as will not cause injury to public health nor to public or private property, nor to existing work, nor to the work completed or in progress, nor cause any interference with the use of the same by the public. Under no circumstances place concrete, place fill, or install appurtenances in excavations containing free water.

### 3.03 SHEETING AND BRACING

- a. The Contractor shall furnish, put in place, and maintain such sheeting and bracing, etc., as may be required to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation below that necessary for proper construction, or otherwise injure or delay the work or endanger adjacent structures or personnel. If the Owner's Representative is of the opinion that sufficient or proper supports have not been provided at any points, he may order additional supports put in at the expense of the Contractor.
- b. Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled with sand borrow and compacted.
- c. The Contractor shall leave in place, to be embedded in the backfill, all sheeting, bracing, etc., which the Owner's Representative may direct him to leave in place at any time during the progress of the work, for the purpose of preventing injury to structures, personnel, utilities or property at no additional cost. Timber or steel sheeting and bracing to be left in place shall be cut-off at least two (2) feet below finish grade. This shall not constitute a waiver of the Contractor's responsibility to use his own judgement as to where sheeting shall be left in place, regardless of the Owner's Representative's direction.

- d. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately back-filled with approved material and compacted by ramming with tools especially adapted to that purpose, by watering, or otherwise as may be directed.

### 3.04 TRENCH HAND EXCAVATION

- a. When approaching the vicinity of the dripline of trees to remain, any roots from vegetation on abutting properties, underground pipes, conduits, or other structures, or any suspected functioning underground features, digging by machinery shall be discontinued and the excavation shall be done by hand. Hand excavation shall also be undertaken when so directed by the Owner's Representative. Such hand excavation shall be considered incidental to the trench excavation and no additional compensation will be allowed.
- b. Protection of Existing Structures - All existing pipes, conduits, poles, wires, fences, curbing, property line markers, and other structures which, in the opinion of the Owner's Representative, are not required to be changed in location, shall be carefully supported and protected from injury by the Contractor, and in case of damage, they shall be restored by the Contractor without additional compensation, to as good a condition as that in which they were found.

### 3.05 BACKFILLING IN OPEN TRENCH

- a. As soon as practical after the pipe has been installed and tested, back-filling shall begin, and shall thereafter be prosecuted expeditiously.
- b. Drainage pipe shall be back-filled with Suitable Backfill or Gravel Borrow from a plane one (1) foot above the top of the pipe to the proposed subgrade.
- c. The area around the pipe shall be bedded with Sand Borrow and back-filled only with suitable backfill material conforming to paragraphs 2.01d or 2.02b of this Specification, or Gravel Borrow from the mid-diameter of the pipe to twelve (12) inches above the top of the pipe. Substitute crushed stone as specified if water is encountered.
- f. Water pipe shall be back-filled with Suitable Backfill material or Gravel Borrow from six (6) inches above the top of the pipe to the proposed subgrade. The area around the pipe shall be bedded and back-filled only with Sand Borrow per these specifications, to six (6) inches above the top of the pipe.

### 3.06 BASE COURSE

- a. The gravel shall be spread and compacted in layers not exceeding six (6) inches in depth compacted measurement and all layers shall be compacted to not less than ninety-five percent (95%) of the maximum dry density of the material as determined by the Standard AASHTO Test Designation T99 compaction test Method C at optimum moisture content as determined by the Engineer. If the material retained on the #4 sieves is fifty percent (50%) or more of the total sample this test shall not apply and the material shall be compacted to the satisfaction of the Engineer. The specific density of the Gravel Sub-base shall be maintained by determining the number of passes of a roller required to produce a constant and uniform density, after conducting a series of tests either using the sand/volume method or the nuclear device.
- b. Compaction shall continue until the surface is even and true to the proposed lines and grades within a tolerance of three-eighths (3/8) inch above or below the required cross sectional elevations and to a maximum irregularity not exceeding three-eighths (3/8) inch under a ten (10) foot line extended longitudinally. Any specific area of gravel sub-base which, after being rolled, does not form a satisfactory, solid, stable foundation shall be removed and replaced and/or recompacted by the Contractor without extra compensation.
- c. All tests for compaction shall be as ordered by the Engineer and paid for by the Contractor, regardless of their result.

### 3.07 SAND BORROW

- a. The Contractor shall deliver, spread and compact Sand Borrow to conform to the lines and grades shown on the plans, and shall spread and compact the Sand Borrow in no greater than six (6) inch layers.
- b. Compaction shall continue until the surface is even and true to the proposed lines and grades indicated on the plans or as directed by the Engineer.
- c. Sand shall not be placed if it is excessively moist and unable to be satisfactorily spread and compacted.
- d. Compaction for Sand Borrow shall be not less than ninety-five percent (95%) of the maximum dry density as determined by the standard AASHTO-T99, Standard Proctor Test.
- e. Compaction of the sand and any adjoining embankment material shall be done simultaneously so that the respective materials will be confined substantially to

the indicated lines.

- f. Sand borrow shall be graded to a true even surface to the proposed lines and grades within a tolerance of three-eighths (3/8) inches above or below the required elevation.
- g. Any tests of materials, and/or compaction, shall be as ordered by the Engineer and paid for by the Contractor regardless of their result. Percolation tests to be verified in the field by Owner's Representative.

- - - END OF SECTION - - -

## SECTION 02510

### WATER SERVICE SYSTEM

#### PART 1 - GENERAL

##### 1.01 SCOPE OF WORK

- a. Work under this section shall include the extension of an existing, on-site water service (three-inch) to support the Water Spray Area, irrigation system, hose bib, and drinking fountain, as indicated on the drawings.
- b. Responsibilities will include furnishing and installing of type “K” piping as sized on the plans, tapping sleeves, corporation stops and boxes, curb stops and boxes, PVC service pipe, thrust blocks, straps and clamps for pipe restraints, strainers, backflow preventers, testing and disinfection (sterilization) of mains, installation of required backflow preventers, and all other specified work and connections as shown on the plans and details. The work by the Contractor shall be performed in accordance with the recognized plumbing standards and all applicable standards. The work shall include all fittings and piping and other appurtenances necessary for complete and proper installation of the work, including connections to the existing work. All lines shown are approximate and must be coordinated with other utilities or site improvements to be installed.
- c. All work herein described and/or shown on the Plans shall be in strict accordance with the best-recognized practices for water service installations. The standards set forth in the selection of materials and supplies are intended to conform to those adopted by the Owner, and the Contractor shall further familiarize himself with the Owner’s requirements when the occasion or choice of materials or supplies so demand.
- d. Per Owner regulations and requirements, the Contractor performing the work of this section shall be an MA licensed master plumber.
- e. The Owner, through their authorized agents, reserves the right to make inspections of the work during its manufacture or progress. The City Plumbing Inspector must be notified of all work and City permit approval process followed. All plumbing work shall be inspected or approved by City Plumbing Inspector before any backfilling occurs. Photos are not acceptable. Contact information to be provided by Owner’s Representative to Contractor.
- f. Sheeting, shoring and bracing, excavation and backfill shall be accomplished in accordance with these Specifications and the applicable provisions of the Standard Specifications. The cost of the sheeting, shoring and bracing, unclassified excavation and backfill shall be included under the Lump Sum Bid.

## 1.02 RELATED SECTIONS

- a. Refer to Section 02885 Water Play Equipment, 02810 Irrigation, 02815 Drinking Fountain and 02515 Backflow Preventer Cabinet, for related work.

## PART II - MATERIALS

### 2.01 MATERIALS

- a. Gate Valve
  1. Gate valves for water lines shall be New York Pattern Metropolitan Type or AWWA C500-71, in accordance with requirements of the Owner. Gate valves shall turn right to open and be rated at 200 psi working pressure; 350 psi hydrostatic test pressure. Gate valve outlet and connection shall be furnished with threaded joints.
  2. Gate valve stems shall be manganese bronze having tensile strength of not less than 35,000 psi, and an elongation of not less than 15% in 2 inches.
  3. Gate valves shall be furnished with O-ring stem seat that utilizes two O-rings. The upper O-ring shall serve as the pressure seal. The design of the valve and seal plate shall be such that the seal plate can be fitted with new O-rings when the valve is under pressure in the fully open position. Housing for the valve stem thrust collar shall be carefully machined and fully bronze lined.
  4. Gate valve disc shall be cast iron and shall be accurately machined to receive bronze disc seat ring. The disc seat ring surface in contact with the iron disc and the conetail projections shall be rolled, peened or pressed into the machine grooves on the iron discs and when secured in place, a rough and finish cut shall be taken over the disc seat ring bearing surfaces.
  5. Gate valve wedges shall be made of bronze.
- b. Copper Tubing
  1. (a) Copper pipe for buried service diameter as stated on plans, as required, shall be soft, annealed, seamless copper tubing conforming to Federal Specification WW-T-799E or ASTM



Standard B88-76, Type "K".

- (b) Copper service pipe for installation in meter pits, valves, manholes, and backflow preventer cabinets, 3 inch diameter and smaller, shall be ASTM B88, Type "K", hard copper tubing.
  - (c) The Contractor shall furnish the Owner with satisfactory evidence that the copper tubing meets the requirements of these Specifications.
2. Joints in the copper service shall be kept to a minimum.
- (a) For buried application, joints shall be made with cast brass three-part compression couplings or flared tube fittings conforming to ANSI Standard Specifications B16.26, latest issue. Bends in copper service pipe, particularly gooseneck bends, shall be made with tool especially designed for the purpose.
  - (b) Pipe joints inside meter vaults and backflow preventer cabinets shall be fittings conforming to ANSI B16.18 cast bronze solder fittings, or ANSI B16.22 wrought copper solder fittings and couplings. Solder shall be ASTM B32, Grade 95 TA, up to 250 degrees. Solder threaded bronze fittings will be used for connections of pipe to meters, strainers, valves, backflow preventers and pipe nipples..
- c. PVC Piping
- 1. PVC pipe shall be as sized on the drawings and details, Class 200, SDR 21, solvent weld PVC, ASTM No. D1784 as manufactured by Cresline or approved equal.
  - 2. Fittings for all PVC piping shall be Schedule 40 solvent weld PVC as manufactured by Dura, Lasco, or approved equal.
  - 3. PVC solvent shall conform to ASTM and be NSF approved. Solvent shall be appropriate for gluing of pipes and fittings up to 6 inches in size. Solvent shall be as manufactured by IPS, Rectorseal, UniWeld, or approved equal and shall be used in conjunction with an appropriate primer.
- d. Poly-braid Tubing
- 1. Poly-braid tubing for drinking fountain supply line shall be 3/8", FDA approved for dinking water and able to withstand 300 psi pressure.

- e. Water Meters
  - 1. Water meters shall be as furnished by the Somerville Water Department. The Contractor shall provide all coordination and pay all fees associated with the water meter installation.
- f. Meter Pit
  - 1. Existing Meter Pit shall be reconstructed to accommodate full 3" copper water connection from the street to the new water meter location in the cabinet shown on sheet LM-1.
- g. Backflow Preventer
  - 1. Backflow preventer for water spray area, irrigation system, and hose bib shall be 3" Reverse Pressure devices, Watts #009-M2Q2, or approved equal.
  - 2. Backflow preventer for drinking fountain shall be 3/4" Reduced Pressure Zone Assemblies, Febco Series 825Y, or approved equal.
  - 3. All Backflow preventers to be approved by the City's Plumbing Inspector prior to installation.

### PART III - EXECUTION

#### 3.01 PIPE AND FITTINGS

- a. All pipe, fittings and such other items shall be carefully examined for defects immediately before lowering into the trench and no pipe or fittings shall be laid which is known to be defective in anyway. Any pipe or fitting discovered as defective after laying shall be promptly removed and replaced. Proper and suitable tools and appliance for the safe and convenient handling and laying of the pipe, fittings and appurtenances shall be used, and great care shall be taken to prevent damage to the pipe coating and lining. Pipe and fittings shall be thoroughly cleaned before being lowered into the trench and shall be kept clean until accepted in the completed work. Open ends shall be closed with wooden or other suitable bulkheads at all times when pipe laying is not actually in progress. Pipes shall be carefully lowered into trenches with rope slings or other mechanical means. Rolling or dropping the pipe into trenches will not be permitted. Whenever the pipe requires cutting to fit the line, the work shall be done only by experienced persons and in such a manner as to leave a smooth end at right angles to the axis of the pipe.

- b. Each length of pipe, fitting or valve shall be firmly supported for its entire length upon original undisturbed trench bottom. Permanent blocking will not be permitted. Where temporary blocking is used, it shall be removed. The underside of the pipe, fittings or valve shall be completely filled and thoroughly compacted with bank gravel before refilling trenches. Fittings and valves shall be carefully set in the line, plumb and true to grade and thoroughly compacted to a firm and uniform bearing.

### 3.02 JOINTING

- a. Jointing shall be in strict accordance with the manufacturer's recommendation for the type of joint being made. Jointing of pipe or fittings shall be made only by persons thoroughly skilled in this work.

### 3.03 BACKFLOW PREVENTERS, METERS AND RELATED APPURTENANCES

- a. The installation of all the new backflow preventers and meter and related valves, hangers, straps, clamps and other appurtenances shall be accomplished in a safe, and complete manner by licensed plumbers.
- b. All work in this regard shall be completed in compliance with Municipal standards and industry requirements and to the satisfaction of the project representatives. Installation shall be approved by City Plumbing Inspector.
- c. Connections between backflow preventers and supply lines shall be complete and include appropriate fittings to mitigate any difference in sizing between the various components.

### 3.04 CONDUCTING TEST FOR LEAKAGE

- a. Description
  - 1. Test for leakage shall be conducted on all portions of completed water work. In trenches, the testing shall be conducted with partial backfilling over the barrel of the pipe, but all joints between the pipe, fittings and valves shall be left exposed for the duration of the tests. At the Engineer's direction, temporary backfilling of certain portions of the completed work may be required prior to conducting leakage tests.
  - 2. All air shall be released and the mains completely filled with water, and after allowing twenty-four (24) hours for absorption the internal pressure shall be built up to an equivalent hydrostatic head of three hundred-fifty (350) feet of water of one hundred-fifty (150) pounds per square inch, and so maintained for the full period of tests.

3. All visible leaks in the joints shall be stopped, and any cracks or defective pipe, fitting or valve shall be removed and replaced.
4. The test shall be conducted for a period of at least sixty (60) minutes after all visible leaks have been stopped, and the inflow of water from a force pump to maintain the required pressure shall not exceed seventy (70) gallons per inch of internal diameter per mile of pipe per day.
5. In case the specified rate of leakage is exceeded, the leaks shall be found and repaired, and the mains shall be re-tested until the required conditions are met.

### 3.05 DISINFECTION OF NEW MAINS

- a. Upon completion, all water mains shall be disinfected as follows:
  1. Pipes shall be completely filled with water; all air released, and then thoroughly flushed out in the amount twice the capacity of the section to be treated. A disinfecting solution of the Sodium Hypochlorite shall be introduced into the main near the point of water supply, in the concentration of one hundred (100) parts of available chlorine per million parts of water. The main shall then be washed or bled from the extreme end opposite to the point of application of the disinfecting supply, and the wasting continued until tests indicate the disinfecting solution has reached the end opposite to the point of application in the concentration of not less than fifty (50) parts available chlorine.
  2. All gates shall then be closed, and the disinfecting solution left in the mains under full pressure for a period of not less than forty-eight (48) hours. The entire section shall then be repeatedly and thoroughly flushed out until all traces of chemicals are removed.
  3. Samples of water shall then be taken by the Contractor and laboratory analysis made by him to determine the effectiveness of treatment.
  4. Any main or section of pipe failing to meet laboratory standards for disinfecting shall be repeatedly treated until the desired results are obtained. A COPY OF LABORATORY REPORTS SHALL BE PROVIDED TO THE OWNER BY THE CONTRACTOR WITHIN FIVE (5) DAYS AFTER TESTING IS COMPLETED.
  5. Particular attention is directed to the requirement that a double check valve installation shall be made in the water supply to the main under treatment, to prevent possible backflow or siphonage of treated solution into the distribution system in service.

### 3.06 OTHER DATA

- a. All iron castings shall conform to the latest revisions of ASTM Designation A126 or physical and chemical requirements.
- b. All ironwork shall be thoroughly cleaned and painted with two coats of asphaltum or other varnish or paint that the Engineer may approve. After the valves are assembled and tested, a third coat shall be applied to the exterior. All composition tool-finished work shall be left bright and unpainted.
- c. All connections shall be made permanently watertight.
- d. All other work required to complete the improvements listed in the Contract Documents shall be accomplished in accordance with the requirements of the Owner.

**- - - END OF SECTION - - -**

## **SECTION 02625**

### **DRAINAGE PIPE**

#### **PART 1 - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. Under this Section the Contractor shall furnish all materials, equipment, labor, transportation, facilities and all operations and adjustments required for the installation of drainage and subdrain pipe and all incidentals thereto.
- b. Drainage and subdrainage pipe shall be placed in the sizes and lengths indicated on the plans.
- c. Provide all coordination and pay all fees associated with installation of the sewer connection.

##### **1.02 SHOP DRAWINGS/MANUFACTURER'S CUTS AND SPECIFICATIONS**

- a. The Contractor shall submit to the Landscape Architect for approval all materials and equipment proposed for use indicating manufacturers' names and addresses, identifying data and expected delivery dates. No consideration will be given to partial lists submitted from time to time. Intention of using specified materials and equipment shall not relieve the Contractor from submitting the above list, nor shall submission of the list relieve him from submission of shop drawings. Any item of material or of equipment not submitted for approval on the list will not be approved unless of the exact make and characteristics specified. Refer to Submittal Section of these Specifications.
- b. If the material or equipment is installed before it is approved, the Contractor shall be liable for the removal and replacement at no extra charge to the Owner, if, in the opinion of the Landscape Architect, the material or equipment does not meet the intent of the Contract Documents.
- c. The Contractor shall submit the following information with all equipment shop drawings:
  1. Manufacturer's certified scale drawings, cuts or catalogs, including installation details.
  2. Manufacturer's specifications, including certified performance characteristics and capacity ratings.

### 1.03 SAMPLES

- a. The Contractor shall submit all samples as requested in accordance with the provisions of the GENERAL CONDITIONS. Samples accepted will be returned to the Contractor within five (5) days and may be incorporated into the work. Samples not accepted will be returned for disposition by the Contractor.

### 1.04 CODES, ORDINANCES AND PERMITS

- a. All work shall be performed in strict accordance with local and state codes and regulations.
  1. Site utilities work shall be done in strict accordance with the Commonwealth of Massachusetts State Plumbing Code, latest edition, and all revisions thereto.
  2. Any material or workmanship called for in the above-mentioned requirements, which are not specified or shown on the drawings, shall be furnished and installed by the Contractor as though same has been specifically mentioned or indicated. If the drawings and specifications are at variance with any regulations, the bidder shall notify the Landscape Architect ten (10) days before the date for submitting his bid. In many cases the drawings are in excess of the requirements in the codes and these shall be followed to the fullest. If the Contractor fails to notify the Landscape Architect at this time and installs work in variance with the above-mentioned codes and regulations, he shall assume the responsibility and the expense to rectify the installation.
  3. Before commencing work, the Contractor shall obtain all permits necessary in connection with the installation of this equipment and pay fees required for same. He shall include the cost and backcharge of installing any portion of the work where performed by municipal departments or utility companies. City reserves the right for inspection and approval of all work.

### 1.05 SUBSTITUTIONS

- a. Any reference to a particular device, product, material, article or system shall be interpreted as establishing a standard of quality, design, performance, or function, and shall not be construed as limiting competition.

### 1.06 RECORD DRAWINGS

- a. The Contractor shall submit record drawings as specified in the GENERAL

CONDITIONS.

1.07 SITE VISITATION

- a. It is recommended that all prospective bidders visit the job site to acquaint themselves with the general and special conditions that may be encountered which will have a bearing on labor, transportation, cutting and patching, material handling and storage, and similar items, during the prosecution of the work. Failure to do so shall not relieve him of his responsibility for properly estimating the difficulties involved in the work to be performed under this section.

1.08 REFERENCE STANDARDS

- a. References herein to any technical society, organization, group or body is made in accordance with the following abbreviations.

ASTM            American Society for Testing Materials

AWWA           American Water Works Association

Massachusetts Standard Specifications.

1.09 MATERIALS AND WORKMANSHIP

- a. It is the intent of these specifications to establish quality standards for all material and equipment incorporated in the work of this section. All material and equipment installed hereunder shall be new and shall be the best of each respective kind and type. Proper care shall be exercised in handling all equipment and materials herein specified.
- b. The installation shall be as indicated on the drawings and in accordance with the manufacturer's recommendations as approved by the Landscape Architect. The installation shall be accomplished by workmen skilled in this type of work.
- c. All conduits, pipes, structures, etc. in use and which are damaged during excavation, whether uncovered or not and whether or not they are shown on the plans, shall be repaired at the expense of the Contractor.
- d. Storage of materials by the Contractor for incorporation into the work shall be off the site for other than material that is scheduled to be installed in the time span of two (2) working days. The storage site selected by the Contractor shall be made accessible to the City inspection forces at all times during normal working hours.



## PART II-MATERIALS

### 2.01 GENERAL

- a. Drawings and specifications are intended to supplement and explain each other. Materials not specifically mentioned in the specifications shall be as indicated on the drawings. Where conflicts occur between the drawings and/or specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the Contractor's bid. Where no specific kind of quality of material is given, a first-class standard article shall be furnished.

### 2.02 DRAINAGE PIPE

- a. PVC Pipe for use as storm drainage lines shall contain integrally belled and spigot joints. The standard dimension ratio (SDR) of all pipe and fittings shall not exceed 35. Standard pipe lengths shall be twenty (20) feet unless otherwise approved. All necessary glues, gaskets and fittings shall be furnished in order to make the work complete and acceptable to the Engineer.
- b. Furnish pipe in the sizes indicated on the plans and/or details.

### 2.03 CRUSHED STONE

- a. Refer to Specification Excavation, Borrow and Backfill Section of these specifications.

### 2.04 APPURTENANCES

- a. Provide all appurtenance and incidentals necessary to make the sewer pipe installation and connection complete and acceptable, including all materials necessary for the excavation, backfill, compaction and restoration of right-of-way pavements, sidewalks and curblines.

## PART III - EXECUTION

### 3.01 PIPE INSTALLATION

- a. Prior to excavating trenches the Contractor shall field verify all existing inverts and inform the Landscape Architect of any discrepancies. Record these inverts on Record Drawings.
- b. The trench for the pipe shall be excavated to the required line and grade and be of sufficient width to permit thorough tamping of the fill material under the haunches

and around the pipe. Soft or unsuitable material encountered below the normal bedding line of the pipe shall be removed as directed, replaced with gravel and thoroughly compacted. The bottom of the trench shall be shaped to conform to the curvature of the pipe. This bed shall also be excavated to accommodate the bells of pipes.

- c. The pipe shall be laid true to the specified lines and grades where shown on the Plans and as directed. The bell end shall be toward rising grade and each section of pipe shall have a firm bearing throughout its length. Material placed around and under the pipe shall be free of stones larger than three (3) inches in diameter.
- d. No load greater than three (3) tons shall be moved over any pipe until a fully-compacted backfill of at least two (2) feet has been placed over the top of the pipe. This minimum will be increased to three and one-half (3-1/2) feet for a forty thousand (40,000) pound single wheel load and to four (4) feet for a sixty thousand (60,000) pound single wheel load. The required fully-compacted backfill cover shall be placed a minimum of fifty (50) feet on both sides of the pipe crossing. However, compliance with this requirement is not to be construed as relieving the Contractor of any responsibility concerning damage to the pipe.
- e. Backfill for pipes shall conform to Section 02350 of these Specifications and shall be placed between the pipe and the walls of the trench in layers not exceeding six (6) inches in depth and thoroughly compacted. Each layer, if dry, shall be moistened and then compacted by rolling or by tamping with mechanical rammers. Compaction with iron hand tampers having a tamping face not exceeding twenty-five (25) square inches in area may be allowed only after permission has been given by the Landscape Architect. Special care shall be taken to thoroughly compact the fill under the haunches of the pipe. This method of filling and compacting shall be continued until the material is level with the top of the pipe. The remainder of the filling shall consist of suitable material placed in successive layers not more than six (6) inches in depth. Each layer shall be thoroughly compacted in accordance with AASHTO-T99 Standard Proctor Test.
- f. Any pipe showing settlement after laying or which is not in true alignment or is otherwise unsatisfactory before final acceptance of the work shall be taken up and replaced or relayed by the Contractor without additional compensation.

### 3.02 WATER REMOVAL

- a. If water is encountered during construction, provisions must be made to remove the water by sheeting and pumping as required, or laying the pipe with a crushed stone bed so that the laying of pipe and other work can be done under stable conditions, all in accordance with Section 02350 of these Specifications.

- b. Owner's Representative shall be notified immediately if such conditions are encountered onsite.

**- - - END OF SECTION - - -**

## SECTION 02630

### DRAINAGE STRUCTURES

#### PART I - GENERAL

##### 1.01 SCOPE OF WORK

- a. The work to be done under this section shall include the installation of standard drainage structures as shown on the plans and specified under this item. The Contractor shall provide all material, labor, tools, equipment and transportation to complete these items. A grate and cover shall be provided for each structure.
- b. Drainage structures shall be installed in the quantities and locations identified on the Contract Drawings. Contact the Project Representative if obstructions or conflicts are encountered.

##### 1.02 REFERENCE STANDARDS AND SPECIFICATIONS

- a. Reference to the standards, specifications and tests of technical societies, organizations, and governmental bodies is made in the Contract Documents.
  1. AASHTO - American Association of State Highway and Transportation Officials (tests or specifications).
  2. ASTM - American Society for Testing and Materials.
  3. Mass. Standard Specs. - Latest edition of the Standard Specifications for Highways and Bridges, the Massachusetts Highway Department, hereinafter referred to as "the Massachusetts Standard Specifications", Sections 2.01, M2.01 and M4.05 AND Plate #203.1.0 of the 1977 MDPW Construction standards.
  4. Municipal Standard Specifications and Procedures, as applicable.
  5. MAAB – Massachusetts Architectural Access Board
  6. ADA – Americans with Disabilities Act

##### 1.03 CODES, ORDINANCES AND PERMITS

- a. All work shall be performed in strict accordance with local and state codes and regulations.

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1. Site utility work shall be done in strict accordance with the Commonwealth of Massachusetts State Plumbing Code, dated September 1976, and all revisions thereto.

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2. The Contractor shall secure all permits deemed necessary in connection with the installation of this equipment and pay fees required for same. He shall include the cost and back charge of installing any portion of the work where performed by municipal departments or utility companies.

#### 1.04 SUBMITTALS/SHOP DRAWINGS

- a. Shop drawings shall be submitted to the engineer for all equipment. Copies shall be submitted and shall include cuts, scale drawings, installation details, manufacturer's specifications, certified performance characteristics and capacity ratings.
- b. No material or equipment may be purchased or installed before the submission and written approval of the shop drawings.

#### PART II - MATERIALS

##### 2.01 PRECAST REINFORCED CONCRETE STRUCTURES

- a. Precast reinforced concrete structures shall comply with material, design and construction standards specified under ASTM C-478.
- b. Minimum compressive strength of concrete in bases, risers and top sections shall be 4,000 psi.
- c. All joints shall be made with rubber gaskets meeting the requirements of ASTM C-443 (AASHTO M198).
- d. Sumps shall be a minimum of 4' depth for catch basins located in paved areas.
- e. Catch basins in planted drainage swale areas shall be 4.5' deep with an 18" sump, see Sheet GD-1 for grades and invert information.

##### 2.02 CLAY SEWER BRICKS (FOR ADJUSTING NEW FRAMES)

- a. Clay sewer brick shall conform to the requirements of AASHTO Designation M91 with the following exceptions:
  1. The size of brick furnished shall be 8" x 3-3/4" x 2-1/4" nominal dimensions.

2. The average of the absorption of five (5) representative samples shall not exceed fifteen percent (15%) and the individual absorption of any one sample shall not exceed seventeen and one-half percent (17-1/2%). The average compressive strength of the five (5) representative samples shall not be less than three thousand (3,000) pounds per square inch and the compressive strength of any one sample shall not be less than two thousand-five hundred (2,500) pounds per square inch.

#### 2.03 CEMENT MORTAR (FOR ADJUSTING NEW FRAMES)

- a. Mortar shall be composed of one (1) part of Portland cement and two (2) parts of sand by volume with sufficient water to form a workable mixture. Cement, sand and water shall conform to the applicable provisions of Mass. Standard Specifications, M4.02.15.

#### 2.04 CEMENT CONCRETE

- a. Material shall comply with Section 03300 of these Specifications.

#### 2.05 CASTINGS

- a. Iron castings (frames, grates and covers) shall conform to the MHD Construction Manual standard designs and to the requirements of AASHTO Designation M105, Class No. 30, Gray Iron Castings, unless otherwise specified. Test Bar B, 1.20 inches in diameter.
- b. Beehive Frames and Grates for installation with catch basins in planted stormwater swales shall be Model R-2564 as manufactured by Neenah Foundry Company, 2121 Brooks Ave., Neenah, WI 54956, Toll Free 800-558-5075

#### 2.06 INLETS

- a. Drain inlets (including grates, risers and sump boxes) shall be NDS, Inc. parts (800-726-1994) or approved equal.
- b. 12" x 12" grate shall be NDS #1213 ADA Compliant, heavy-duty cast iron, black.
- c. 12" x 12" x 6" riser shall be NDS #1216
- d. 12" x 12" x 12" inlet box shall be NDS # 1217, with one opening for 6" pipe. Plug additional openings with Universal Adaptor Plug or NDS park # 1206.
- e. 12" x 12" x 12" sump box shall be NDS # 1225

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- f. Set and backfill inlets with compacted crushed stone. Seal all joints with adhesive per manufacturer's recommendations.

## 2.07 SPECIAL MIX FOR SUBDRAINS

- a. Where designated, crushed stone for subdrains shall conform to the MHD Standard Specifications M2.01.6.
- b. A zone of crushed stone as shown in the details, meeting this specification, shall be placed around the entire perimeter of the subdrain structure.

## PART III - EXECUTION

- 3.01 Structures of various types and depths shall be constructed to the line, grades, dimensions and design shown on the plans and as directed and furnished with the necessary frames, grates, covers, aluminum steps, etc., in accordance with these Specifications. Verify inverts of all utilities to remain.
- 3.02 The bricks and blocks (if required) shall be wetted as necessary before laying. All joints in brick masonry shall be thoroughly flushed full of mortar and no joints on the inside face shall be greater than one-quarter (1/4) inch. After the bricks and blocks are laid, the joints shall be pointed on the inside. As bricks or blocks are laid up, the outside of the structure shall be plastered with one-half (1/2) inch thick mortar coat.
- 3.03 Connections will be carefully made to all existing and proposed lines to the grades and elevations shown on the contract drawing.
- 3.04 All catch basins shall have an oil trap outlet of an appropriate size and material consistent with specific project requirements for drainpipe.
- 3.05 Unless otherwise directed or specified, two (2) weep holes shall be built into the walls of all new structures. Each weep hole shall consist of a section of four (4) inch pipe or equivalent opening to carry water through the wall of the structure. The outside end of the pipe or opening shall be covered with a one-quarter (1/4) inch mesh galvanized wire screen 23 gauge satisfactorily fastened against the wall. The drain to the weep hole shall be excavated and backfilled with two (2) cubic feet of broken rock or crushed stone. The crushed stone shall be placed against and over the end of the pipe or opening with a section of filter cloth to prevent the entrance of fine material. Only one (1) type of weep hole shall be used consistently throughout the project.
- 3.06 Suitable materials obtained from the excavation or from borrow shall be placed between the outside of the structure and the limits of the excavation, uniformly distributed in

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successive layers not exceeding 6 inches in depth and thoroughly compacted by tamping with mechanical rammers or tampers. When required, the backfill material shall be moistened during the compacting. Compaction with iron hand tampers having a tamping face not exceeding twenty-five (25) square inches may be allowed, but only after permission has been given by the Engineer.

- 3.07 All materials removed in the excavation for catch basins, manholes, drop inlets, drywells, etc., and remaining after the filling about the finished structure has been made shall be used wherever possible within the project or removed and satisfactorily disposed of outside of the project limits without additional compensation.
- 3.08 Frame castings for structures shall be set in full mortar beds true to the lines and grades as directed.
- 3.09 Where directed, the castings shall be temporarily set at such grades as to provide drainage during the construction.
- 3.10 In general, all methods for installation of the catch basin and manhole units, brick adjustments, mortaring, and installation of frames, grates and covers, shall conform to Section 2.01 of the MHD Standard Specifications.
- 3.11 Catch basins located within planted stormwater swale areas shall have rim elevations 6" above surrounding finished grades so they function for stormwater overflow collection only. Frames and grates at these structures shall be beehive model as noted in 2.05.b of this section.
- 3.12 All manhole covers are to be painted black
- 3.13 All exposed drains shall meet current MAAB and ADA regulations for materials and installations.

**- - - END OF SECTION - - -**

## **SECTION 02631**

### **ABANDON STRUCTURES**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

Under this Section the Contractor shall furnish all labor, materials, equipment and transportation necessary to abandon structures (manholes or catch basins) as designated on the plans or as directed by the City Representative to include:

- a. Removal, stacking and delivery of iron frames/castings
- b. Plugging of inlets and outlets
- c. Demolition of top portion of structure (36" min.) and filling in of remaining structure.

##### **1.02 REFERENCE STANDARDS AND SPECIFICATIONS**

- a. All work must conform to MHD Standard Specifications, Division II, Sections 140.26 and 140.63.

#### **PART II - MATERIALS**

##### **2.01 SUITABLE BACKFILL**

- a. Suitable backfill shall conform to the requirements of Section 02350 - Excavation, Borrow and Backfill.
- b. Gravel for use below new pavements shall meet the requirements for gravel borrow as described in Section 02350.

#### **PART III - EXECUTION**

##### **3.01 CASTINGS**

- a. The present castings shall be carefully removed and satisfactorily stored and protected until they are reinstalled or delivered to a municipal storage facility, located within the City confines, as designated and directed by the Engineer.

### 3.02 INLETS AND OUTLETS, REMOVALS AND BACKFILL

- a. Inlets and outlets of structures to be abandoned shall be plugged with brick masonry not less than eight (8) inches in thickness, conforming to Section 201 of the MHD Specifications. Upper portions of the masonry shall be removed to a depth of two (2) feet below the finished grade at the location designated by the Engineer, and the structures shall be completely filled with suitable material placed in six (6) inch layers and thoroughly compacted.

**- - - END OF SECTION - - -**

## **SECTION 02633**

### **REMODELING OF STRUCTURES**

#### **PART I - GENERAL**

##### **1.01 SCOPE OF WORK**

- a. Work under this section shall consist of remodeling utility structures that require grade changes of more than six (6) inches. The Contractor shall furnish all labor, materials, equipment and transportation required to remodel existing manholes, catch basins, and/or other utility structures.

#### **PART II - MATERIALS**

- a. All new masonry construction, resetting of castings and items, filling around structures and other incidental work, shall be as specified under Sections 02350 and 03300 of these Specifications.
- b. Concrete slab tops shall be precast and steel reinforced per ASTM 12227-93. Concrete shall be 4000 psi/28 day minimum; and H-20 loading capability in areas subject to vehicular traffic.

#### **PART III - EXECUTION**

- a. All the structures to be remodeled shall be altered as to meet proposed grades, including but not limited to excavation, mechanical or manual cutting of existing structures, mortar/grout bedding or parging leveling course materials, slab tops or other devices, compacting of specified backfill to subgrade and final grade adjustments.
- b. The Contractor shall be held responsible for the protection of the castings. Any frames, grates or covers damaged in any manner during the progress of the construction shall be replaced by the Contractor at his expense.
- c. Transportation, delivery and installation of all castings or mechanical items shall be included in the contract price.
- d. Plug any vent-holes in covers to be buried with pressure-treated wood plugs, tapered to fit tightly.

**- - - END OF SECTION - - -**

## SECTION 02810

### IRRIGATION SYSTEM

#### PART 1 - GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Include GENERAL CONDITIONS and applicable parts of Division 1 as part of this Section.
- B. Coordinate work of this Section with other underground utilities and with trades responsible for their installation. Refer to respective Drawings pertaining to other work.

##### 1.2 WORK TO BE DONE

- A. Work to be done includes furnishing all labor, materials, equipment and services required to complete all irrigation work indicated on the Drawings, as specified herein, or both.
- B. The mechanical point of connection for the irrigation system shall be a new 2-inch tap of the domestic water supply provided and installed by others.
- C. The electrical point of connection for the irrigation system shall be to a 120-volt, 20-amp building electrical circuit provided and installed by others.
- D. The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Owner's Representative for decision, and his interpretation shall be final, conclusive and binding.
- E. All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Owner's Representative.
- F. Trench excavation, back filling and bedding materials, together with the testing of the completed installation shall be included in this work.
- G. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work,

whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

- H. Record Drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall also be included in this work.

### 1.3 SCOPE

- A. The irrigation system shown on the Drawings and described within these Specifications represents a single controller, athletic field irrigation system supplied from municipal water. The system is designed for 50 gallons per minute. Minimum 65-psi dynamic pressure at full system flow is required downstream of the backflow preventer.

### 1.4 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements that affect the Work of this Section.
  1. Earthwork: Section 02300.
  2. Planting: Section 02950.
  3. Electrical power supply: drawing sheets.

### 1.5 ORDINANCES, PERMITS AND FEES

- A. The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.
- B. The Contractor shall obtain and pay for any and all permits, tests and certifications required for the execution of Work under this Section.
- C. Furnish copies of Permits, Certifications and Approval Notices to the Owner's Representative prior to requesting payment.
- D. The Contractor shall include in their bid any charges by the Water Department, Utility Company, or other authorities for work done by them and charged to the Contractor.

### 1.6 EXAMINATION OF CONDITIONS

- A. The Contractor shall fully inform himself of existing conditions on the site before submitting his bid, and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions

encountered in the actual Work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the GENERAL CONDITIONS.

## 1.7 QUALITY ASSURANCE

- A. Installer: A firm which has at least five (5) years experience in work of the type and size required by this Section and which is acceptable to the Owner's Representative.
- B. References: The Contractor must supply three references for work of this type and size with their bid including names and phone numbers of contact person(s).
- C. Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:
  - 1. American Society for Testing & Materials (ASTM)
    - a. ASTM: A536 Ductile Iron Castings
    - b. ASTM: D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
    - c. ASTM: D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and CI200.
    - d. ASTM: D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
    - e. ASTM: D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
    - f. ASTM: D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
    - g. ASTM: F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
    - h. ASTM: D2737-99 Polyethylene (PE) Pressure rated tube.
  - 2. National Plumbing Code (NPC)
  - 3. National Electric Code (NEC)
  - 4. National Sanitary Foundation (NSF)
  - 5. American Society of Agricultural Engineers (ASAE)
  - 6. Underwriters Laboratories, Inc. (UL)

7. Occupational Safety and Health Regulations (OSHA)

1.8 TESTS

- A. Observation: The Owner's Representative will be on site at various times to insure the system is being installed according to the Specifications and Drawings.
- B. Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner's Representative. Demonstrate to the Owner's Representative that all irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the Drawings or where the system has been willfully installed when it is obviously inadequate or inappropriate without bringing it to the attention of the Owner. See Part 3 - Execution).
- C. The Owner's Representative shall be notified 48 hours in advance for observations.
- D. During final observation, the contractor shall be responsible for having two-way communication and sufficient personnel to provide instantaneous communication between the observation area and the controller for the system.

1.9 SHOP DRAWINGS

- A. The Contractor shall provide copies of product specification sheets on all proposed equipment to be installed to the Owner's Representative for approval prior to the start of work, in accordance with the parameters of Division-1. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:
  - 1. Layout of a 5-zone system for the rectangular field area shown on plans with appropriate equipment schedules for optimal coverage
  - 2. Sprinkler Heads
  - 3. Valves: Manual and Automatic
  - 4. Master Valve
  - 5. Controller/ Enclosure
  - 6. Flow Sensor
  - 7. Decoders
  - 8. Valve Boxes



9. Pipe and Fittings
10. Wire and Connectors
11. Quick Coupling Valves
12. Rain Sensor
13. Backflow Prevention Device/ Enclosure
14. Grounding Equipment
15. Miscellaneous Materials

B. Project Record Documents:

1. The Contractor shall provide and keep up-to-date a complete Record Set of Drawings of the system as the project proceeds. Drawings shall be updated daily, showing every change from the original Drawings and Specifications. Record Drawings shall specify and exactly locate sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller(s), rain sensor(s), quick coupling valves, water meters, back flow prevention device and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types). Prints for this purpose may be obtained from Owner's Representative at cost. This record set of drawings shall be kept at job site and shall be used only as a record set.
2. This set of documents shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. This record set of drawings shall be available at all times for observation and shall be kept in a location designated by Owner's Representative. Should this record set of drawings not be available for review or not be up-to-date at the time of the observation, it will be assumed no work has been completed. Provide copies of the redlined record set of drawings for Owner's Representative review on a monthly basis.
3. Make neat and legible notations on this record set of drawings daily as the work proceeds, showing the work as actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, indicate that equipment in a graphic manner in the location of installation and so as to match the original symbols as indicated in the irrigation legend. Should the equipment be different from that specified, indicate with a new graphic symbol both on the drawings and the irrigation legend. The relocated

equipment dimensions and northing and easting coordinates should then be transferred to the appropriate drawing in this record set of drawings at the proper time.

4. On or before the date of final field observation, deliver corrected and completed AutoCAD computer plots of “record drawings” on vellum and AutoCAD electronic files on disk to Owner’s Representative as part of contract closeout. Delivery of plots will not relieve Contractor of the responsibility of furnishing required information that may have been omitted from the prints.
- C. At the end of each segment of the project the contractor shall submit the following to the Owner’s Representative.
1. Plumbing permits.
  2. Material approvals.
  3. Pressure line tests: By whom approved and date.
  4. Materials furnished: Recipient and date.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage.

#### 1.11 GUARANTEE

- A. The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.
- B. In addition to the manufacturers guarantees the Contractor shall warrant the entire irrigation system, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.
- C. As part of the one-year warranty the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system.
- D. Should any problems develop within the warranty period because of inferior or faulty materials or workmanship, they shall be corrected to the satisfaction of the Owner’s Representative at no additional expense to the Owner.
- E. A written warranty showing date of completion and period of warranty shall be supplied upon completion of each segment of the project.

## 1.12 COORDINATION

- A. The Contractor shall at all times coordinate his work closely with the Owner's Representative to avoid misunderstandings and to efficiently bring the project to completion. The Owner's Representative shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. The Contractor shall also coordinate his work with that of his sub-contractors.
- B. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Owner's Representative.

## 1.13 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. Contractor shall include in their Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Owner's Representative office shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).
- B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE HODGKINS\_CURTIN PARK IRRIGATION SYSTEM, shall be submitted to the Owner's Representative office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:
  - 1. Table of Contents
  - 2. Written description of Irrigation System.
  - 3. System drawings:
    - a. One (1) copy of the Record Drawing;
    - b. One (1) reproducible of the Record Drawing;
    - c. One (1) copy of the controller valve system wiring diagram
  - 4. Listing of Manufacturers.

5. Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.
  - a. "APPROVED" submittals of all irrigation equipment;
  - b. Operation:
  - c. Maintenance: including complete troubleshooting charts.
  - d. Parts list.
  - e. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.
6. Winterization and spring start-up procedures.
7. Guarantee data.

#### 1.14 PROCEDURE

- A. Notify all city departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.
- B. Provide and install temporary support, adequate protection and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed or reconstructed as directed by the Architect.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL

- A. All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.
- B. No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Owner's Representative.

## 2.2 PVC IRRIGATION PIPE

- A. All pipe shall bear the following markings: Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.
- B. All lateral pipe shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 as manufactured by Certainteed, Cresline, JM or equal.
- C. All mainline pipe shall be PVC, Class 200, Type 1120, SDR 21, Gasket-Joint PVC, conforming to ASTM No. D2241 as manufactured by Certainteed, Cresline, JM or equal.
- D. The pipe insertion mark shall be visible to show the proper depth into spigot.

## 2.3 PVC PIPE SLEEVES

- A. All pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Certainteed, Cresline, JM or equal. Minimum sleeve size to be 3-inch.

## 2.4 WIRE CONDUIT

- A. Conduit for wiring beneath non-soil areas shall be PVC, SCH-40 conduit with solvent-weld joints, as manufactured by Certainteed, Cresline, JM or equal.
- B. Sweep ells shall be standard electrical type PVC schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.
- C. Conduit for above ground wiring to rain sensors or controllers shall be galvanized, rigid metallic conduit.

## 2.5 PVC IRRIGATION FITTINGS

- A. Fittings for solvent weld PVC pipe, 2-1/2 inch and smaller in size, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.
- B. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.
- C. All PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 threads will not be approved for installation.
- D. PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 and 80 fittings. Cement is to meet ASTM D2564 and FF493 for potable water

pipes. PVC solvent cement shall be Rectorseal Gold, IPS Weld-ON 711, Oatey Heavy Duty Cement or equal, and shall be used in conjunction with the appropriate primer. Primer shall be NSF approved, and formulated for PVC and CPVC pipe applications. Primer is to meet ASTM F 656. Primer shall be Rectorseal Jim PR-2, IPS Weld-ON P-68 Clear, Oatey Clear Primer for PVC and CPVC, or equal.

- E. Fittings for PVC main line pipe, for all directional changes, pipe reductions and plugs 3- inch and larger in size shall be deep bell push-on gasket joint ductile iron fittings for PVC pipe. Fittings shall be manufactured of ductile iron, grade 70-55-05 in accord with ASTM A536 and gaskets shall meet ASTM F477. Fittings shall be as manufactured by Harrington Corporation, Harco, or equal. For main line pipe to zone valve / lateral pipe connections, Harco or equal push-on gasket joint ductile iron service tees shall be used. Saddles, (strap, bolt down or snap) will not be approved for installation.
- F. All nipples to be schedule 80 PVC.

## 2.6 POLYETHYLENE IRRIGATION PIPE

- A. Piping 1-1/2 inch and smaller in size as indicated on the drawings may also be installed with polyethylene (PE3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Oil Creek or equal. Polyethylene pipe shall only be used in landscape areas.

## 2.7 POLYETHYLENE IRRIGATION FITTINGS

- A. Fittings for polyethylene pipe shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) dog-eared stainless steel clamps. Clamps shall be as manufactured by Oetiker or approved equal.
- B. Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco or approved equal.

## 2.8 SPRAY SPRINKLERS

- A. Full and part circle pop up spray sprinklers shall be pressure regulating, plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and in the legend. Pop-up height shall be 4 inches for turf.
- B. Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Rain Bird, Hunter Industries, or approved equal.

## 2.9 LARGE ROTARY SPRINKLERS

- A. Large rotary sprinklers shall be gear-driven, rotary type with drain check valve and stainless steel riser designed for in-ground installation. The nozzle assembly shall elevate three inches when in operation and retraction shall be achieved by a stainless steel spring. Check valve shall be capable of holding up to 10 feet of elevation. Sprinkler shall be capable of covering a 49-61 foot radius and flow range of 7.5 to 15.7 gpm at 60 pounds per square inch of pressure.
- B. All sprinkler parts shall be removable through the top of the unit by removing a heavy-duty threaded cap. The sprinkler shall have a one- inch (1") IPS water connection on the bottom of the sprinkler.
- C. Sprinklers shall be manufactured by Hunter Industries model I25-ADS/36S, Rain Bird model 7005-SS, equivalent Toro fixture or approved equal.

## 2.10 ELECTRIC CONTROL VALVES

- A. Electric control valves shall be one, one and one half and two-inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.
- B. Valves shall be manufactured by Rain Bird model PEB, Hunter Industries model ICV or approved equal.

## 2.11 MASTER VALVE

- A. Electric control valves shall be three inch remote control, diaphragm type, brass valve with manual flow control, manual toggle switch with internal porting, 200 psi pressure rating and 24 volt activation. Valve shall be equipped with a self-flushing filter, self cleaning metering rod, stainless steel solenoid seat and operate with a slow closure speed.
- B. Valves shall be manufactured by Weathermatic 1 ½-21000 series or approved equal.

## 2.12 VALVE BOXES

- A. All valve boxes shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. All boxes shall be green in color. Covers shall be green in color unless otherwise specified.
- B. Valve boxes for single electric valves, isolation valves, and quick coupling valves shall be 10-inch round valve boxes with metal detection and bolt down covers

- C. Valve boxes for dual electric valves and master valve shall be 12-inch standard valve boxes with metal detection and bolt down covers.
- D. Valve boxes for wire splices shall be 10 inch round valve boxes with detectable disks as manufactured by Armor, Part 181104 or 181112. All splices shall be in separate valve boxes and not included with isolation valves
- E. Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer.
- F. Valve boxes shall be manufactured by Armor or approved equal.

#### 2.13 AUTOMATIC CONTROLLER

- A. Controller shall be as manufactured by Hunter Industries model ACC-99D or approved equal.

#### 2.14 DECODERS

- A. Decoders and sensor decoders shall be as manufactured by Hunter Industries model ICD decoders and ICD-SEN or approved equal.

#### 2.15 QUICK COUPLING VALVES

- A. The valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under all conditions when the key is not inserted.
- B. The top of the valve body receiving the key shall be equipped with a single slot and smooth face to allow the key to open and close the valve slowly with a one-half turn. The quick coupling valve shall be equipped with a vinyl cover.
- A. The valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.
- B. Keys shall be single lug with 1-inch male thread and 3/4-inch female thread at the top.
- C. Contractor shall provide two (2) keys for quick couplers and two (2) 1-inch x 1-inch swivel hose ells.
- D. Quick coupling valves, keys and swivels shall be manufactured by Rain Bird models 5RC, 55K-1 and SH-2, Hunter Industries, model QCV-100, QCV-100K and HS-100 or approved equal.

#### 2.16 WIRE



- A. All valve control wire shall be #14-2 AWG, two wire, twisted copper pair, UL-approved direct burial AWG-U.F. 600V and shall meet all state and local codes for this service.
- B. In ground wire connections shall be UL listed, manufactured by 3M, model DBY-6 splice kits. All wire splices shall be made in valve boxes, at controller, or at valves.
- C. Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.
- D. Wire shall be as manufactured by Hunter Industries model IDWIRE1 in minimum 2500 foot reels or approved equal.

#### 2.17 ISOLATION VALVES

- A. Isolation valves 2-1/2 inches and smaller in size shall be gate type, of bronze construction, US Manufacture, 200 WOG with steel cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco, model T-113-K, or approved equal.
- B. Isolation valves 3 inches and larger in size shall be cast iron epoxy coated inside and outside, long bell length ring-tite valves, 200 psi rated, ductile iron gland flange, bronze stem-seal box, o-ring stem seal replaceable under pressure, stainless steel stem, 2 inch operating nut and replaceable disc conforming to AWWA C-509 as manufactured by Nibco, Model P-619-RW or approved equal.

#### 2.18 SWING JOINTS

- A. Spray sprinklers, small rotary sprinklers and medium rotary sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.
- B. Large rotary sprinklers shall be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double o-ring seals, minimum 315 psi rating and minimum length of 12 inches.
- C. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double o-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of the quick coupling valve).

#### 2.19 AUTOMATIC RAIN SENSOR

- A. Rain sensor shall be plastic in construction with adjustable interruption point, 1/2-inch IPS threads and stainless steel vandal resistant guard. Rain sensor shall be manufactured by Hunter Industries, model Rain-Clik or approved equal with sensor guard.

## 2.20 BACKFLOW PREVENTION DEVICE

- A. Back flow prevention device shall be 2-inch Reduced Pressure Assembly as per Somerville Cross Connection Department requirements. Back flow prevention device shall have maximum 12-psi pressure loss at system flow.
- B. Back flow prevention device shall be as manufactured by Watts model 909 or approved equal.

## 2.21 CRUSHED STONE

- A. Crushed stone shall be as specified in SECTION: EARTHWORK. Crushed stone shall be used under valve boxes.

## 2.23 SAND

- A. Sand used for backfilling of trenches; under, around and over PVC lines shall be as specified in SECTION: EARTHWORK.

## 2.24 CONCRETE BASES AND THRUST BLOCKS

- A. Standard concrete mix shall be in accordance with ASTM C150, ASTM C-33, and ASTM C-94 with a compressive strength (28 days) of 3,000 psi.
- B. All bell and gasket mainline pipe and fittings shall have thrust blocks sized and placed in accordance with pipe manufacturer's recommendations for standard concrete mix. Thrust blocks shall be installed at all tees, elbows, crosses, reducers, plugs, caps and valves. Contractor shall be responsible to insure the stability of all thrust blocks.
- C. All concrete bases shall be standard concrete mix. Sizes shall be as indicated on the Drawings and sited in the Specifications.

## 2.26 SPARE PARTS

- A. Contractor shall supply the following tools and equipment to the Owner's Representative before final observation:
  - 1. Two (2) wrenches for disassembling and adjusting each type of sprinkler head provided.
  - 2. One (1) quick coupler key assembly for every five or fraction thereof of each type of quick coupling valve provided.
  - 3. One (1) of each type of gate valve used in the project.
  - 4. Two (2) of each type sprinkler head and pattern (PC & FC) used in the project.

5. Two (2) of each type nozzle used in the project.

B. Before final observation can occur, written evidence that the Owner's Representative has received the tools and equipment must be shown to the Owner.

### PART 3 - EXECUTION

#### 3.1 GENERAL

A. Before work is commenced, hold a conference with the Owner's Representative to discuss general details of the work.

B. Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Owner's Representative for timely resolution.

C. All work indicated on Drawings shall be provided whether or not specifically mentioned in the Specifications.

D. If there are ambiguities between Drawings and Specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by Owner's Representative, and Contractor shall comply with the decisions. In the event the installation contradicts the directions given, the installation shall be corrected by Contractor at no additional cost to Owner.

E. Verify dimensions and grades at job site before work is commenced. Do not proceed with installation of the landscape irrigation system when it is apparent that obstructions or grade differences exist or if conflicts in construction details. Legend or specific notes are discovered. All such obstructions, conflicts, or discrepancies shall be brought to the attention of the Owner's Representative.

F. Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Owner's Representative prior to proceeding.

G. Layout of sprinkler lines indicated on Drawings is diagrammatic only. Location of sprinkler equipment is contingent upon and subject to integration with all other underground utilities. Contractor shall employ all data contained in the Contract Documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.

H. Coordinate installation of all sprinkler materials, including pipe, to avoid conflict with the trees, shrubs, or other plantings.

- I. During progress of work, a competent superintendent and all assistants necessary shall be on site. All shall be satisfactory to the Owner's Representative. The superintendent shall not be changed, except with the consent of the Owner's Representative, unless that person proves unsatisfactory and ceases to be employed. The superintendent shall represent the Contractor in his absence and all directions given to the superintendent shall be as binding as if given to the Contractor.
- J. At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.
- K. Replace, or repair to the satisfaction of the Owner, all existing paving disturbed during course of work. New paving shall be the same type, strength, texture, finish, and be equal in every way to removed paving.

### 3.2 PIPE AND FITTINGS INSTALLATION

- A. Using proper width trencher chain, excavate a straight (vertical) and true trench to a depth of 2-inch of pipe invert elevation.
- B. Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.
- C. Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1-inch or sharp edges; if not, excavate to 2-inch below pipe invert and provide and install sand base or crushed stone upon which to lay pipe.
- D. Back filling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock larger than 1-inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.
- E. Do backfilling when pipe is cool. During hot weather cool pipe by operating the system for a short period, or by backfilling in the early part of the morning before the heat of the day.
- F. Do not, under any circumstances, use truck wheels for compacting soil.

- G. Where feasible, Owner's Representative may authorize the use of flooding in lieu of tamping.
- H. Restore grades and repair damage where settling occurs.
- I. Clean bell and spigot ends and make all gasketed joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of lubricant, and wiping off any excess lubricant from each connection. Maximum deflection per joint shall not exceed manufacturer's recommendations.
- J. Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow welded joints at least 15 minutes set-up/curing time before moving or handling. When the temperature is above 80° F, allow connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80° F, follow manufacturer's recommendations. Provide and install for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).
- K. Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of COVER for PVC and 12 inches of cover for Polyethylene (excavate to invert as required by pipe size).
- L. Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.
- M. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40° F or below. Pipe installed at temperatures below 40° F shall be removed and replaced at no cost to the Owner. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.
- N. In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1-inch and larger.

- O. Maintain 6-inch minimum clearance between sprinkler lines and lines of other trades. Do not install sprinkler lines directly above another line of any kind.
- P. Maintain 1-inch minimum between lines which cross at angles of 45 to 90 degrees.
- Q. Exercise care when excavating, trenching and working near existing utilities.
- R. Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.
- S. Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

### 3.3 THRUST BLOCKING

- A. All ringtite bell-end fittings shall be blocked with an adequately sized thrust block as per ASAE Standard S376.1 and as depicted in the details. Blocking shall be in accordance with pipe and fitting manufacturer's recommendations. Thrust blocks shall be required at all changes in size and direction of bends, reducers, plugs and tees. Thrust blocks shall be installed against undisturbed soil in all cases. Concrete thrust blocks shall utilize 3,000-psi standard concrete mixture. Bricks, stones, boulders, etc. will not be accepted as thrust blocks or thrust block material. Sackcrete will not be permitted as a thrust blocking material. Contractor to supply all material needed for thrust blocking.
- B. Size of thrust block shall be determined by working pressure, size and type of fitting, and soil conditions. Calculate area required for concrete thrust block in contact with soil. Refer to fittings manufacturer's thrust block sizing table to determine size of thrust block for each condition.
- C. Ensure stability of thrust blocks.
- D. Under no circumstances will concrete block be approved for thrust blocks including for 2-inch fittings.

### 3.4 ELECTRICAL WIRE CONDUIT INSTALLATION

- A. Electrical conduit shall be installed in all non-soil areas, as well as for all above ground wiring where wire passes under or through walls, walks and paving to controllers and rain sensor.
- B. Conduit shall extend 18 inches beyond edges of walls and pavement.

### 3.5 PIPE SLEEVING INSTALLATION

- A. Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 24 inches as shown on the detail.
- B. Sleeving shall extend 18 inches beyond edges of walls and pavement.

### 3.6 ISOLATION VALVE INSTALLATION

- A. Install isolation valves per detail where indicated on the Drawings. Install all isolation valves on a level crushed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.
- B. Check and tighten valve bonnet packing before valve box and backfill installation.
- C. Provide and install thrust blocks for ring-tite valves as per detail.

### 3.7 VALVE BOX INSTALLATION

- A. Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, decoder and wire splice.
- B. All valve access boxes shall be installed on a minimum 4-inch crushed stone base. Finish elevation of all boxes shall be at grade. All crushed stone to be supplied by the Contractor and installed before valve box. Crushed stone shall not be poured into previously installed valve boxes.

### 3.8 24 VOLT CONTROL AND MASTER VALVE INSTALLATION

- A. Control valves shall be installed on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.
- B. Install at sufficient depth to provide not more than 6-inch, nor less than 4-inch cover from top of valve to finish grade.
- C. Adjust zone valve operation after installation using flow control device on valve.
- D. Master valve shall be placed in a standard valve box.

### 3.9 WIRING INSTALLATION

- A. Wiring shall be installed along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be

laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

- B. All wire shall be laid in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and back-filled. The wires shall have a minimum of 12 inches of cover. Wire not to be installed that day shall not be laid out.
- C. An expansion curl shall be provided and installed within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five (5) turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.
- D. Provide and install a two wire path to all 24 volt valves and sensors within the project. Maximum distance of any two wire path shall not exceed 10,000ft.
- E. Service wiring in connection with Drawings and local codes for 24-volt service. All in-ground wire connections shall be waterproofed with 3M DBY-6 splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used). Splice locations shall be shown on the Record Drawings.
- F. Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

### 3.10 CONTROLLER INSTALLATION

- A. Contractor to install controller in enclosure, generally where shown on the drawings. Contractor to wire valves, master valve, flow sensor and rain sensor into controller and set proper program.
- B. Wire controller to 120-volt electrical supply provided and installed to the controller locations by OTHERS.
- C. Keys shall be turned over to Owner's Representative.



### 3.11 GROUNDING INSTALLATION

- A. Each grounding rod shall be driven into the ground its full length within 8-feet of the controller and connected via a Cadweld connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe. Plates shall be installed 36 inches below grade with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs of Power Set ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe.
- B. Multiple controller locations shall have separate grounding for each controller. Grounding rods shall be separated a minimum of 20 feet between grids. Grids shall be installed in an irrigated area.
- C. When tested, grounding grid shall have an earth resistance no greater than 5 ohms. If earth resistance is greater than 5 ohms, additional grounding plates and enhancement material shall be added to system until desired test results have been meet.

### 3.12 RAIN SENSOR INSTALLATION

- A. Install rain sensor on exterior building wall, generally where indicated on the drawings. Coordinate final location of rain sensor with Owner's Representative. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.
- B. Install rain sensor wiring within 1/2-inch conduit where exposed. All above ground wires shall be installed in conduits.
- C. Wire rain sensor directly to controller.

### 3.13 FLOW SENSOR

- A. Wire sensor directly to controller.

### 3.14 SPRINKLER INSTALLATION

- A. Spray sprinklers, small rotary sprinklers and medium rotary sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.
- B. Large rotary sprinklers shall be installed flush to grade on 1-inch prefabricated PVC unitized swing joint assemblies with integral o-rings, minimum length 12 inches.
- C. Sprinklers shall not exceed maximum spacing indicated
- D. Adjust sprinkler zone after installation using flow control device on valve.

### 3.15 QUICK COUPLING VALVE INSTALLATION

- A. Provide and install quick coupling valves where indicated on the Drawings.
- B. Quick coupling valves to be mounted on 1-inch prefabricated PVC unitized swing joint assemblies with integral o-rings, minimum length 12 inches with brass insert and stabilizer as per details.

### 3.16 BACKFLOW PREVENTION INSTALLATION

- A. Install 2-inch reduced pressure back flow prevention assembly in above grade enclosure as specified. Back flow installation shall be in accordance with Somerville Cross Connection Department.

### 3.17 CHECK/TEST/START-UP/ADJUST

- A. Flushing:
  1. After all piping, valves, sprinkler bodies, pipe lines and risers are in place and connected, but prior to installation of sprinkler internals, open the control valves and flush out the system under a full head of water.
  2. Sprinkler internals, flush caps and riser nozzles shall be installed only after flushing of the system has been accomplished to the full satisfaction of the Owner's Representative.
  3. Contractor shall be responsible for flushing the entire system after installation is complete and will be responsible for any clogged nozzles for thirty (30) days after substantial completion of this portion of the landscape irrigation system.
- B. Testing:
  1. Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.

2. Coverage test: perform a coverage test in the presence of the Owner's Representative (notify Architect at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.
3. All testing shall be at the expense of the Contractor.

### 3.18 CLEANING AND ADJUSTING

- A. At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves and fittings shall be cleaned of grease, metal cuttings and sludge which may have accumulated by the operation of the system for testing.
- B. Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.
- C. Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.
- D. Each control zone shall be operated for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

### 3.19 ACCEPTANCE AND OPERATION BY OWNER

- A. Upon completion of the work and acceptance by the Owner, the Contractor shall be responsible for the training of the Owner's Representative(s) in the operation of the system (provide minimum 48 hours written notice in advance of test). The Contractor shall furnish, in addition to the Record Drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. The Contractor shall guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.
- B. Conditions for acceptability of work for start of maintenance by Owner issued by Owner or Owner's Representative shall include but not be limited to:
  1. Punch list items complete and approved by Owner or Owner's Representative.
  2. Landscape irrigation system complete and in place.
  3. Record drawings complete.

4. Maintain installation and watering schedules until all conditions noted above have been completed.

### 3.20 CLEAN UP

- A. Upon completion of all installation work, Contractor shall remove all leftover materials and equipment from the site in a safe and legal manner.
- B. Contractor shall remove all debris resulting from work of this section.
- C. Contractor shall regrade, lightly compact, and replant around sprinkler heads where necessary to maintain proper vertical positioning in relation to established grade.
- D. Contractor shall fill all depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage. Compact lightly, and replant filled areas in accord with Drawings requirements.

END OF SECTION